Appendix B

CALSIM II Modeling Studies of the Delta Mendota Canal/California Aqueduct Intertie

CALSIM II Modeling Studies of the Delta Mendota Canal/California Aqueduct Intertie

PREPARED FOR: Patricia Roberson/USBR

PREPARED BY: Armin Munévar/SDO

COPIES: Michelle Light/USBR
Allan Highstreet/SAC
Rob Tull/SAC

DATE: June 18, 2004

Introduction

The proposed action, known as the Delta Mendota Canal (DMC) and California Aqueduct Intertie (Intertie), consists of construction and operation of a 400 cfs pumping plant and pipeline connections between the DMC and California Aqueduct. The Intertie alignment is proposed for DMC milepost 7.1 where the DMC and California Aqueduct are about 400 feet apart.

The Intertie provides operational flexibility between the DMC and California Aqueduct. It does not result in any changes to authorized pumping capacity at Tracy Pumping Plant or Banks Delta Pumping Plant.

The average daily pumping capacity at the Tracy PP is limited to 4,600 cubic-feet-per-second (cfs) which is the existing capacity of the upper DMC and its intake channel. However, due to conveyance limitations in the lower DMC and other factors, pumping at Tracy PP is almost always less than 4,600 cfs. DMC conveyance capacity is affected by subsidence, canal siltation and deposition, the amount timing and location of water deliveries from the DMC, the facility design, and other factors. By linking the upper DMC with the California Aqueduct, the Intertie would allow year-round Tracy pumping up to 4,600 cfs, subject to all applicable export pumping restrictions for water quality and fishery protections. Tracy PP capacity would remain limited to its existing authorized pumping capacity of 4,600 cfs.

Overview of CALSIM II Studies

Four CALSIM II modeling studies were developed to update and supplement the previous modeling studies completed earlier this year (April 2003). Two new *Base* studies (without Intertie) were developed to provide maximum consistency with the model and hydrologic input changes and assumptions that are being used for the CALSIM II modeling developed for the OCAP ESA Consultation. One represents existing level of development and demands (2001 LOD) and the other approximates future conditions (2020 LOD). Significant refinements to the CALSIM II model and associated hydrology were developed in early 2003 through a series of meetings between staff of BOR CVO, DWR OCO, agency planning groups, and consultants. Among the modifications included are reductions/elimination of

NOD contractor and minimum flow shortages, hydropower operations and reservoir balancing, CVPIA (b)(2) decision and accounting updates, and DWR hydrology updates.

Two new *Alternative (Intertie)* studies were also developed to simulate the project. These studies include equal CVPIA (b)(2) and EWA actions as the Base studies and attempt to operate at the same level of risk as the Base studies to facilitate evaluation of true project effects.

Study Methodology and Assumptions

The current planning model used by DWR and USBR is CALSIM II, a general-purpose simulation model of the combined CVP/SWP systems as well as a host of smaller water supply entities with which the CVP/SWP systems interact. A geographically comprehensive model, CALSIM II includes the Sacramento River basin, the San Joaquin River basin, and the Delta, as well as portions of the Tulare Basin and Southern California. CALSIM II provides a platform for assessing changes in Delta water quality and water supply operations of the CVP and SWP projects. All water supply evaluations of the Intertie utilized the CALSIM II model.

The sections that follow outline the hydrologic and operational assumptions behind the Intertie modeling analyses. These assumptions are consistent across all studies with the exception that the Alternative studies include the Intertie project and fixed CVPIA (b)(2) and EWA actions.

Geographic Coverage

The valley floor drainage area of the Sacramento and San Joaquin Rivers, the upper Trinity River, and the San Joaquin Valley, Tulare Basin, and southern California areas served by the Federal Central Valley Project (CVP) and the California State Water Project (SWP) are simulated in CALSIM II. The focus of CALSIM II is on the major CVP and SWP facilities, but operations of many other facilities are included to varying degrees.

Hydrology

CALSIM II includes a hydrology developed jointly by DWR and USBR. Water diversion requirements (demands), stream accretions and depletions, rim basin inflows, irrigation efficiencies, return flows, non-recoverable losses, and groundwater operation are components that make up the hydrology used in CALSIM II. Sacramento Valley and tributary rim basin hydrologies are developed using a process designed to adjust the historical sequence of monthly stream flows to represent a sequence of flows at a future level of development. Adjustments to historic water supplies are determined by imposing future level land use on historical meteorological and hydrologic conditions. San Joaquin River basin hydrology is developed using fixed annual demands and regression analysis to develop accretions and depletions. The resulting hydrology represents the water supply available from Central Valley streams to the CVP and SWP at a future level of development.

Delta Water Quality

CALSIM II uses DWR's Artificial Neural Network (ANN) model to simulate the flow-salinity relationships for the Delta. The ANN model correlates DSM2 model-generated salinity at key locations in the Delta with Delta inflows, Delta exports, and Delta Cross

Channel operations. The ANN flow-salinity model estimates electrical conductivity at the following four locations for the purpose of modeling Delta water quality standards: Old River at Rock Slough, San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville. In its estimates, the ANN model considers antecedent conditions up to 148 days, and considers a "carriage-water" type of effect associated with Delta exports.

CVP/SWP Delivery Logic

The delivery logic CALSIM II utilizes in determining deliveries to north-of-Delta and south-of-Delta CVP and south-of-Delta SWP contractors uses runoff forecast information which incorporates uncertainty and standardized rule curves (i.e. Water Supply Index versus Demand Index Curve) to estimate the water available for delivery and carryover storage. Updates of delivery levels occur monthly from January 1 through May 1 for the SWP and March 1 through May 1 for the CVP as water supply parameters become more certain. The south-of Delta SWP delivery is determined based upon water supply parameters and operational constraints. The CVP system wide delivery and south-of-Delta delivery are determined similarly upon water supply parameters and operational constraints with specific consideration for export constraints.

CVPIA 3406(b)(2) Water

CALSIM II incorporates procedures for dynamic modeling of CVPIA 3406(b)(2) water and the Environmental Water Account (EWA), under the CALFED Framework and Record of Decision (ROD). Per the October, 1999 Decision and the subsequent February, 2002 Decision, CVPIA 3406(b)(2) accounting procedures are based on system conditions under operations associated with SWRCB D-1485 and D-1641 regulatory requirements. Similarly, the operating guidelines for selection of actions and allocation of assets under the EWA are based on system conditions under operations associated with SWRCB D-1641 regulatory requirements. This requires sequential layering of multiple system requirements and simulations.

CVPIA 3406(b)(2) allocates 800 TAF (600 TAF in Shasta critical years) of CVP project water to targeted fish actions. The full amount provides support for SWRCB D-1641 implementation. According to monthly accounting, 3406(b)(2) actions are dynamically selected according to an action matrix. Several actions in this matrix have defined reserve amounts that limit 3406(b)(2) expenditures for lower priority actions early in the year such that the higher priority actions can be met later in the year.

Environmental Water Account

Under CALFED, the EWA acquires water through "operational" and "fixed" assets, and then allocates water to targeted fish actions. "Operational" assets include relaxation of regulatory requirements and dedication of conveyance capacities to EWA purposes. "Fixed" assets are water purchased from willing sellers or previously banked supplies. According to monthly accounting, EWA assets are evaluated and actions are dynamically selected according to an action matrix. Several actions in this matrix have defined reserve amounts that limit EWA allocation for lower priority actions early in the year such that the higher priority actions can be met later in the year, subject to uncertain "operational" assets.

Table 1. CALSIM II Intertie studies assumptions

	Existing Condition (2001)	Future Condition (2020)
Period of Simulation	73 years (1922-1994)	Same
HYDROLOGY		
Level of Development (Land Use)	2001 Level, DWR Bulletin 160-98[1]	2020 Level, DWR Bulletin 160-98
Demands		
North of Delta (exc American R)		
CVP	Land Use based, limited by Full Contract	Same
SWP (FRSA)	Land Use based, limited by Full Contract	Same
Non-Project	Land Use based	Same
CVP Refuges	Firm Level 2	Same
American River Basin		
Water rights	2001[2]	2020, Sacramento Water Forum[3]
CVP	2001[4]	2020, Sacramento Water Forum[5]
San Joaquin River Basin		
Friant Unit	Regression of historical	Same
Lower Basin	Fixed annual demands	Same
Stanislaus River Basin	New Melones Interim Operations Plan	Same
South of Delta		
CVP	Full Contract	Same
CCWD	140 TAF/YR[6]	195 TAF/YR[6]
SWP (w/ North Bay Aqueduct)	3.0-4.1 MAF/YR	3.3-4.1 MAF/YR
SWP Article 21 Demand	MWDSC up to 50 TAF/month, Dec-Mar, others up to 84 TAF/month	MWDSC up to 50 TAF/month, Dec-Mar, others up to 84 TAF/month
FACILITIES		
	Existing Facilities (2001)	Same
REGULATORY STANDARDS		
Trinity River		
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/YR)	Trinity EIS Preferred Alternative (369-815 TAF/YR)

[1] 2001 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160-98

[2] 1998 Level Demands defined in Sacramento Water Forum's EIR with a few updated entries

[3] Sacramento Water Forum 2025 Level Demands defined in Sacramento Water Forum's EIR

[4] Same as footnote 2

[5] Same as footnote 3

[6] Delta diversions include operations of Los Vaqueros Reservoir operations

	Existing Condition (2001)	Future Condition (2020)
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same
Clear Creek		
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS, and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Upper Sacramento River		
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 TAF)	Same
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Feather River		
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 CFS)	Same
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement (1000 – 1700 CFS)	Same
American River		
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same
Lower Sacramento River		
Minimum Flow near Rio Vista	SWRCB D-1641	Same
Mokelumne River		
	Inflow time series from EBMUDSIM	Same
Stanislaus River		
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement , and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Minimum Dissolved Oxygen	SWRCB D-1422	Same
Merced River		
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 CFS, Nov – Mar), and Cowell Agreement	Same
Minimum Flow at Shaffer Bridge	FERC 2179 (25 – 100 CFS)	Same
Tuolumne River		
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF/YR)	Same
San Joaquin River		
Maximum Salinity near Vernalis	SWRCB D-1641	Same
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	Same
Sacrameto River-San Joaquin River Delta		
Delta Outflow Index (Flow and	SWRCB D-1641	Same

	Existing Condition (2001)	Future Condition (2020)
Salinity)		
Delta Cross Channel Gate Operation	SWRCB D-1641	Same
Delta Exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2), and CALFED Fisheries Agencies discretionary use of EWA	Same
OPERATIONS CRITERIA		
Subsystem		
Upper Sacramento River		
Flow Objective for Navigation (Wilkins Slough)	Discretionary 3,250 – 5,000 CFS based on CVP system water supply forecast	Same
American River		
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)	Same
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow	Same
Sacramento Water Forum Mitigation Water	None	Sacramento Water Forum (up to 47 TAF/YR in dry years)
Stanislaus River		
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	Same
San Joaquin River		
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	Same
System-wide		
CVP Water Allocation		
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	Same
CVP Refuges	100% (75% in Shasta Critical years)	Same
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)	Same
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)	Same
SWP Water Allocation		
North of Delta (FRSA)	Contract specific	Same
South of Delta	Based on supply; Monterey Agreement	Same
CVP/SWP Coordinated Operations		
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement	Same
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	Same
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) only restricts CVP exports; EWA use restricts CVP and/or SWP as directed by CALFED Fisheries Agencies	Same
CVPIA 3406(b)(2)		

	Existing Condition (2001)	Future Condition (2020)
Allocation	800 TAF/YR (reduced in dry and critical years based on NOD Ag allocation; not less than 600 TAF/YR)	Same
Actions	1995 WQCP (non-discretionary), Fish flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), VAMP (Apr 15-May 16) CVP export restriction, 3000 CFS CVP export limit in May and June (D1485 Striped Bass continuation), Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Upstream Releases (Feb-Sep)	Same
Accounting Adjustments	Per May 2003 Interior Decision, no limit on responsibility for non-discretionary D1641 requirements, Release and Export metrics only	Same
CALFED Environmental Water Account		
Actions	Total exports restricted to 4000 CFS, 1 wk/mon, Dec-Mar (wet year: 2 wk/mon), VAMP (Apr 15- May 16) export restriction, Pre (Apr 1-15) and Post (May 16-31) VAMP export restriction, Ramping of export (Jun)	Same
Assets	50% of use of JPOD, 50% of any CVPIA 3406(b)(2) releases pumped by SWP, flexing of Delta Export/Inflow Ratio (not explicitly modeled), dedicated 500 CFS increase of Jul – Sep Banks PP capacity, north-of-Delta (0 - 135 TAF/Yr) and south-of-Delta purchases (50 - 185 TAF/Yr), and 200 TAF/YR south-of-Delta groundwater storage capacity	Same
Debt restrictions	No planned carryover of debt past Sep, asset carryover allowed	Same

The Intertie studies were developed by adding a 400 cfs Intertie between the upper DMC and the CA as shown in Figure 1. To more closely represent projected facility operations, water is only routed through the Intertie once the upper DMC capacity is maximized. Simulation of the Intertie enables CVP water pumped at Tracy PP to be wheeled through the CA and subsequently returned to CVP control in O'Neill Forebay. From there the water can be delivered directly to CVP SOD contractors (including wildlife refuges) or stored in San Luis storage for subsequent delivery. Estimates of Tracy capacity that include the potential for delivery to upper DMC demands were edited to reflect the impact of Intertie capacity.

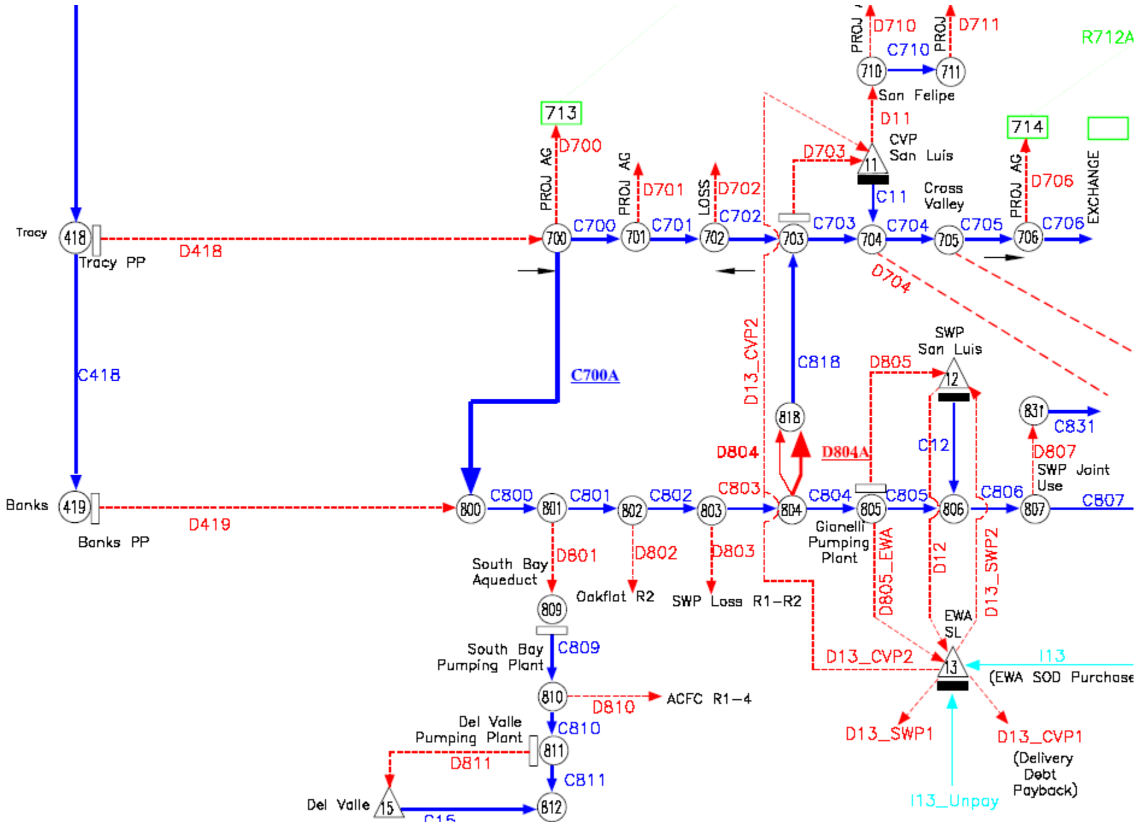

Figure 1: Detail of the CALSIM II Schematic showing Tracy PP, Banks PP, and the Intertie (represented in the model with arcs C700A and D804A).

North of Delta (NOD) storage facility operations were targeted to be similar to those of the Base studies. Higher exports are an anticipated outcome of the enhanced conveyance capacity created by the Intertie, and the additional pumping could come from both storage and Delta surplus. The parameters of the Base studies have been refined to maximize the operational use of the NOD storage facilities under study conditions. The Intertie studies were designed to maintain reasonable levels similar to the Base studies. The model guidelines that index delivery to both water supply and export capacity were adjusted to encourage the full use of restored export capabilities while not taxing NOD resources beyond the operational boundaries reached in the Base studies.

The SWP and CVP share water resources available in the Delta under the Coordinated Operating Agreement (COA). Under current operating conditions, the CVP is not always able to take all of the water it is entitled to due to pumping limitations, including those that arise due to the upper DMC bottleneck. When this is the case, the SWP is permitted to capture the unused CVP water in addition to their share if pumping capacity is available and other operating criteria are satisfied. The CVP water pumped by the SWP is referred to as unused federal share. The Intertie project enables the CVP to recapture some of the CVP water that was previously abandoned to the SWP due to conveyance limitations.

2020 Level of Development Study Results

Intertie Use

The Intertie is assumed to be operable in all months of the year up to full capacity. The long-term average annual Intertie use is 52 TAF/yr. The months of highest use are September through March (Figure 2). July and August also show Intertie use. The Intertie facility enables Tracy PP to be operated at it's maximum capacity in months that the upper DMC restrictions would not have otherwise enabled this to occur. This increase in maximum Tracy PP operable capacity is shown in the Figure 3. The Intertie facility use appears to be rather well distributed across all hydrologic years as can be construed from Figure 4. Only in less than 5% of the years is there no use of the facility. This can be explained by noting that even in the driest sequence of years, there are a number of months of surplus flows that can be captured through the use of the Intertie.

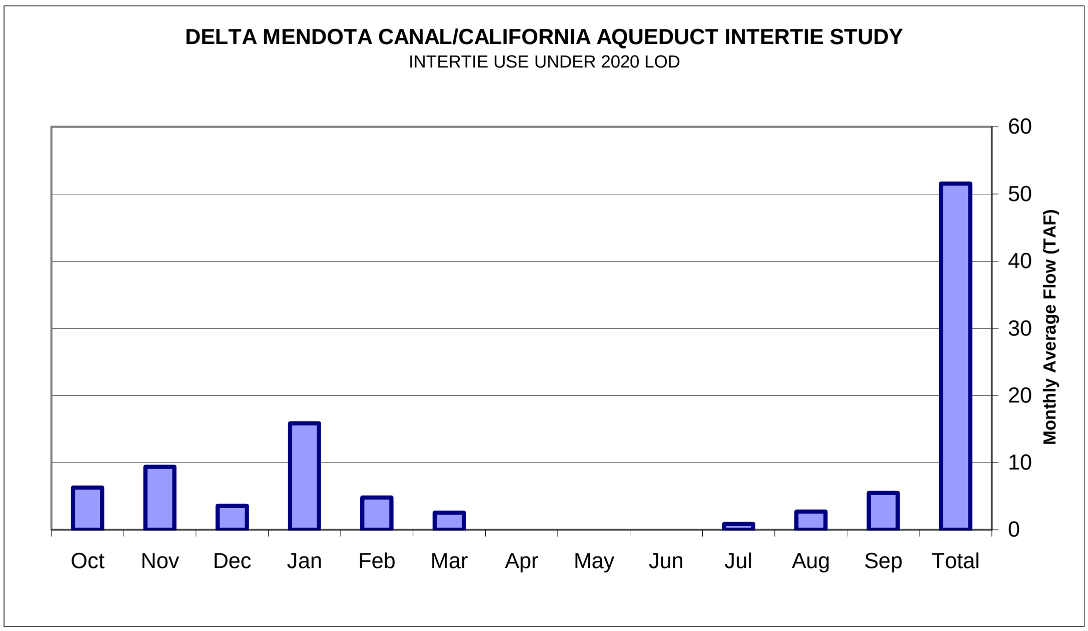

Figure 2. Monthly average Intertie flows (taf) under 2020 LOD.

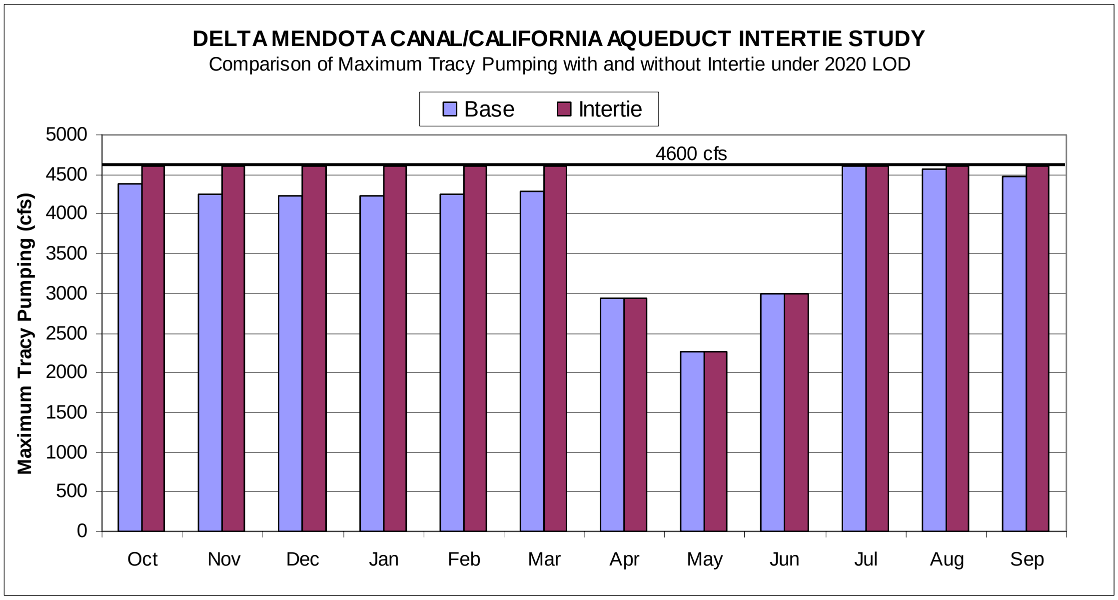

Figure 3. Monthly maximum Tracy pumping (cfs) under 2020 LOD.

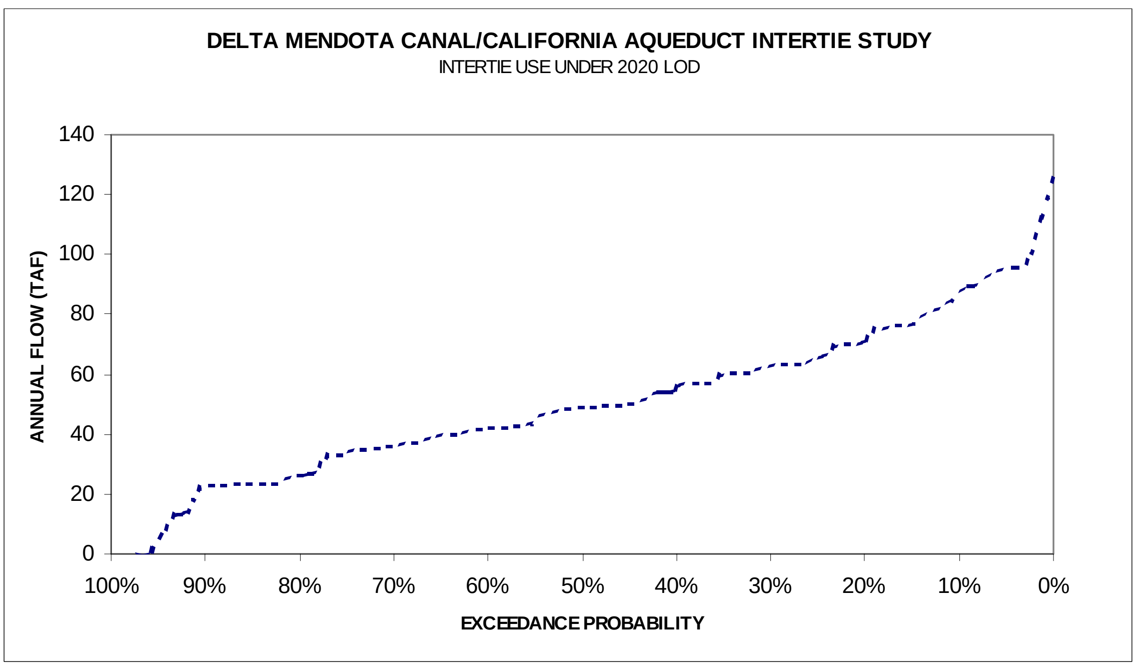

Figure 4: Exceedance probability of annual Intertie use (taf/yr) under 2020 LOD.

Water Supply Impacts

The restored CVP export capacity provided by the Intertie results in changes to deliveries, and these are summarized by Table 2 and Figures 5 and 6. The average annual CVP delivery benefit from the Intertie is 35 taf/yr. The plots in Figures 5 and 6 show annual changes in CVP and SWP total deliveries for the Intertie study compared to the Future No Action (2020 LOD Base). Note that the CVP delivery increase is less than the actual Intertie usage. The explanation for this phenomenon is that the Intertie reduces the need for the CVP use of Banks PP (termed joint point of diversion, JPOD).

The study shows a decrease in SWP SOD delivery of approximately 16 taf/yr averaged over the entire period and 18 taf/yr during the dry period of 1928-1934. The greatest contributor to this decrease is the renewed CVP ability to capture *CVP* supplies that were previous captured by the SWP.

Table 2: Change in water supply deliveries with Intertie under 2020 LOD.

2020 LOD	DRY PERIOD AVERAGE (1928-34)			73-YEAR AVERAGE (1922-1994)		
	BASE	ALTERNATIVE	CHANGE	BASE	ALTERNATIVE	
CVP DELIVERY NOD	1990	1995	5	2273	2275	2
CVP DELIVERY SOD (INCL.CVC)	1674	1703	29	2460	2493	33
CVP DELIVERY TOTAL	3664	3698	34	4734	4769	35
SWP DELIVERY FIRM	2069	2051	-17	3229	3215	-14
SWP DELIVERY ARTICLE 21	56	55	-1	76	73	-3
SWP DELIVERY TOTAL*	2124	2107	-18	3304	3288	-16

* As SWP Entitlement A Delivery

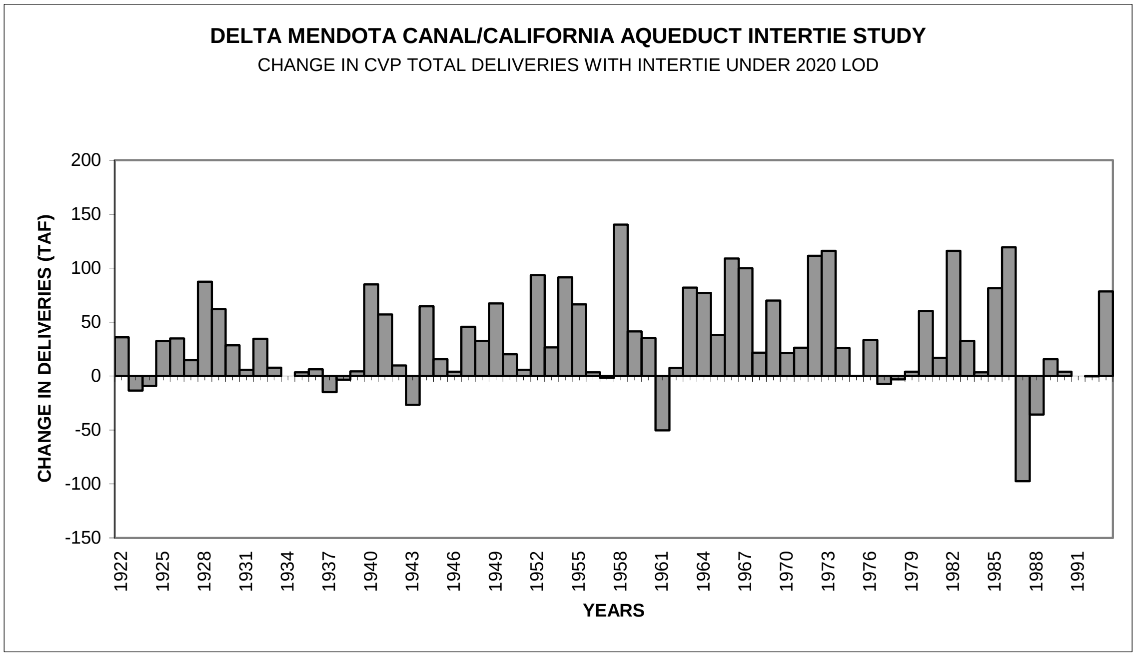

Figure 5: Change in CVP total deliveries with Intertie under 2020 LOD.

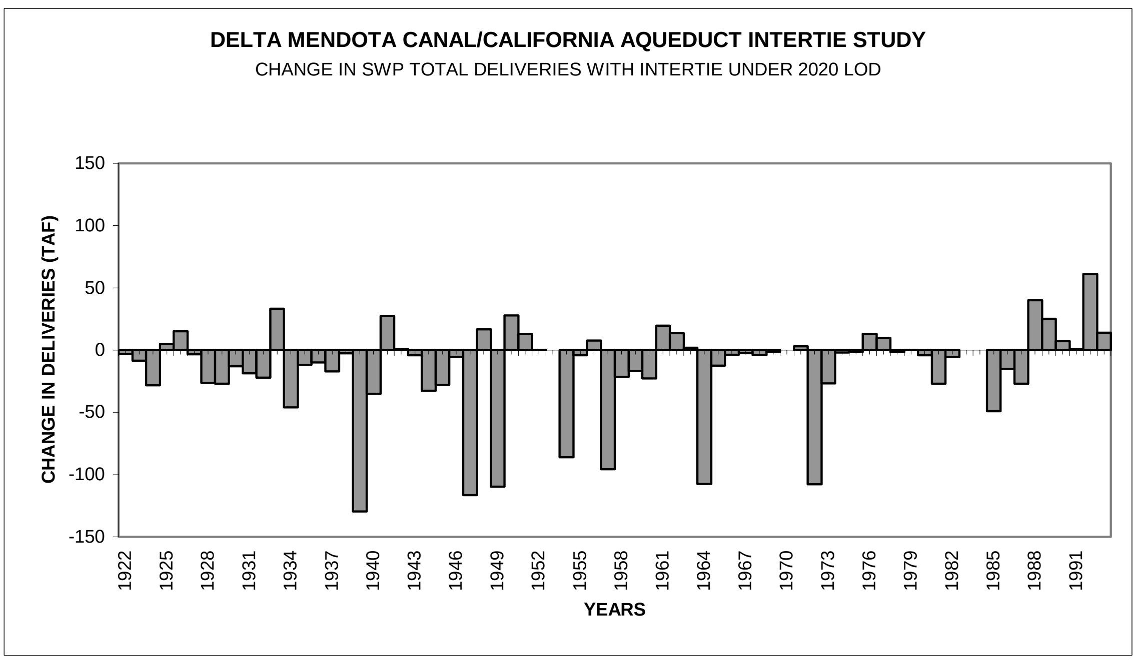

Figure 6: Change in SWP SOD total deliveries with Intertie under 2020 LOD.

San Luis Reservoir Operations

The Intertie conveyance allows water to reach San Luis during the winter months filling cycle where capacity was previously constrained. Figure 7 compares the average end-of-March and end-of-August storage values for the Intertie study to the Future No Action study (2020 LOD Base). The studies show overall increases in CVP San Luis storage levels during the filling period. The increase in March CVP San Luis storage due to the Intertie is shown to be greater than 40 taf in 50% of the years. August CVP San Luis storage is somewhat reduced in a number of wet years with high carryover storage (Figure 8). The reduction in August storage is largely due to more effective delivery allocation scheduling caused by earlier filling. In many of these years, earlier filling of CVP San Luis (before May) allows higher allocations to be made for CVP SOD contractors. The higher allocations, which continue throughout the delivery year, cause more water to be moved from CVP San Luis storage for delivery.

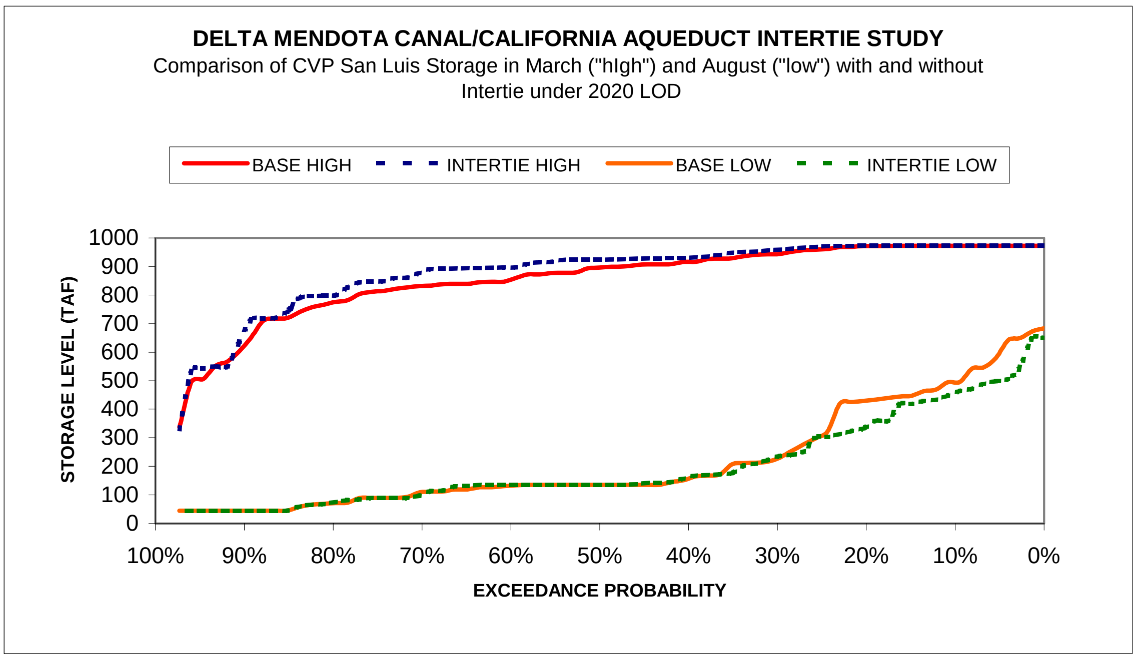

Figure 7: Comparison of CVP San Luis storage in March ("high") and August ("low") under 2020 LOD.

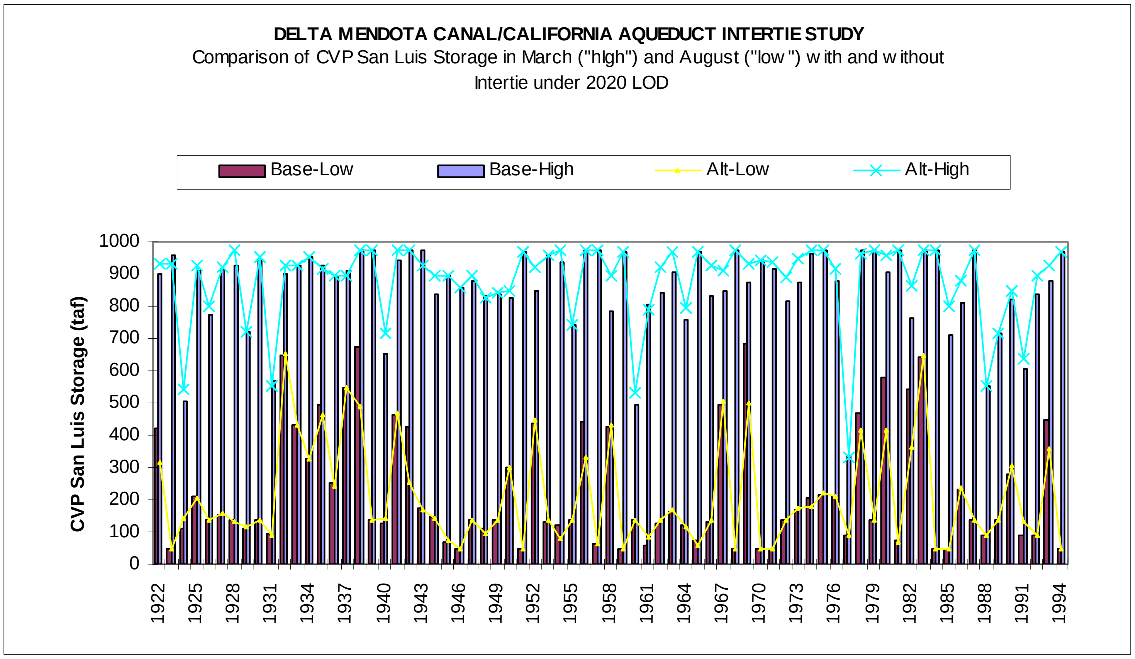

Figure 8: Comparison of CVP San Luis annual storage in March ("high") and August ("low) under 2020 LOD.

North of Delta Storage Impacts

The study was designed to minimize impacts (both positive and negative) to the north of Delta storage conditions. Figures 9 through 12 illustrate the limited nature of the impact of the Intertie project on Trinity, Shasta, Folsom, and Oroville carryover storage conditions.

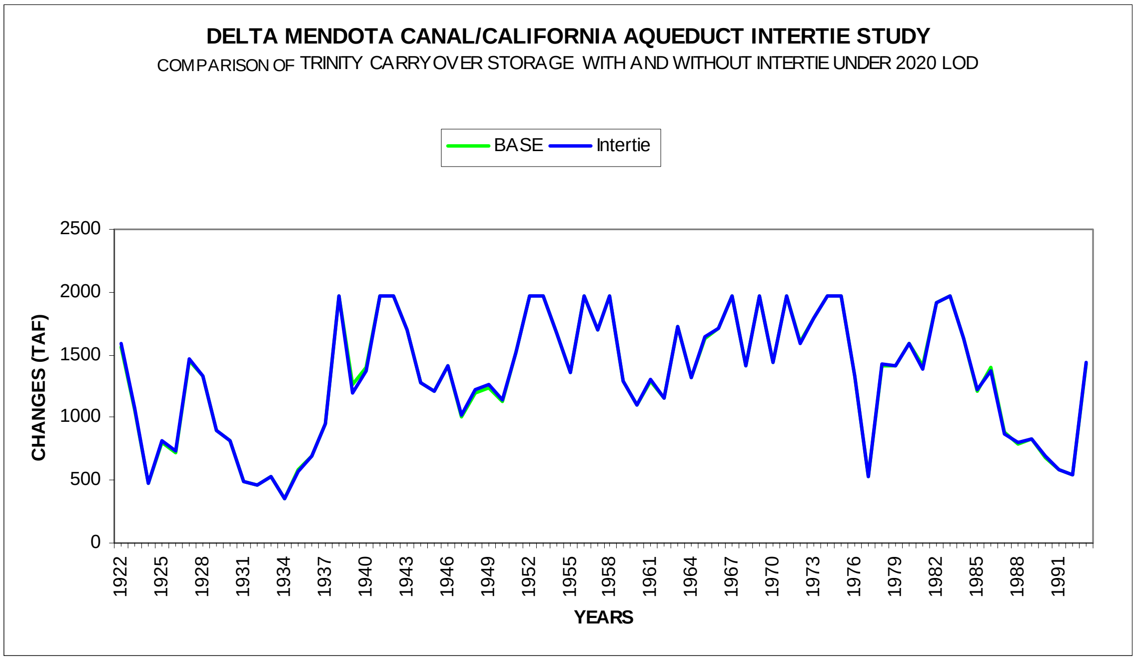

Figure 9: Trinity carryover storage under 2020 LOD.

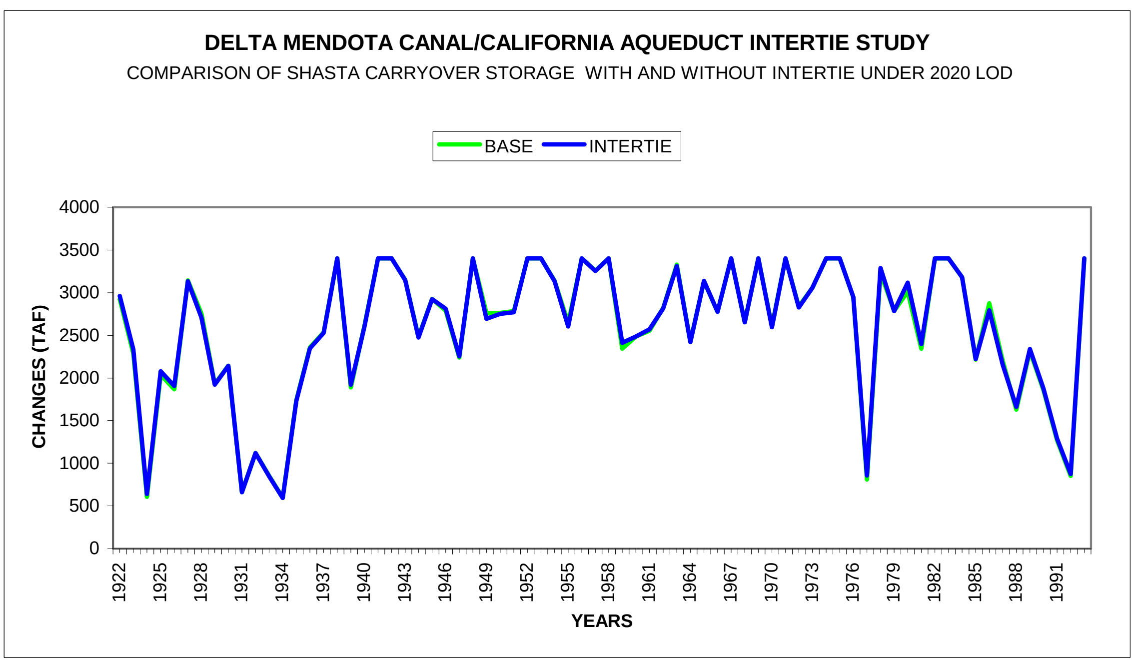

Figure 10: Shasta carryover storage under 2020 LOD.

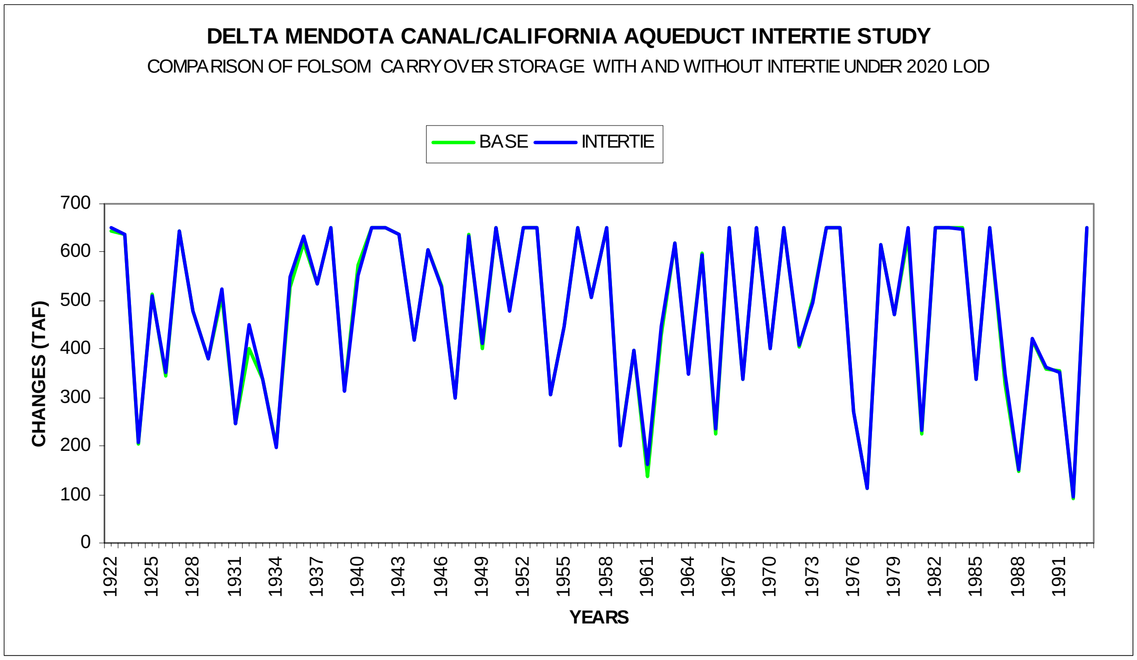

Figure 11: Folsom carryover storage under 2020 LOD.

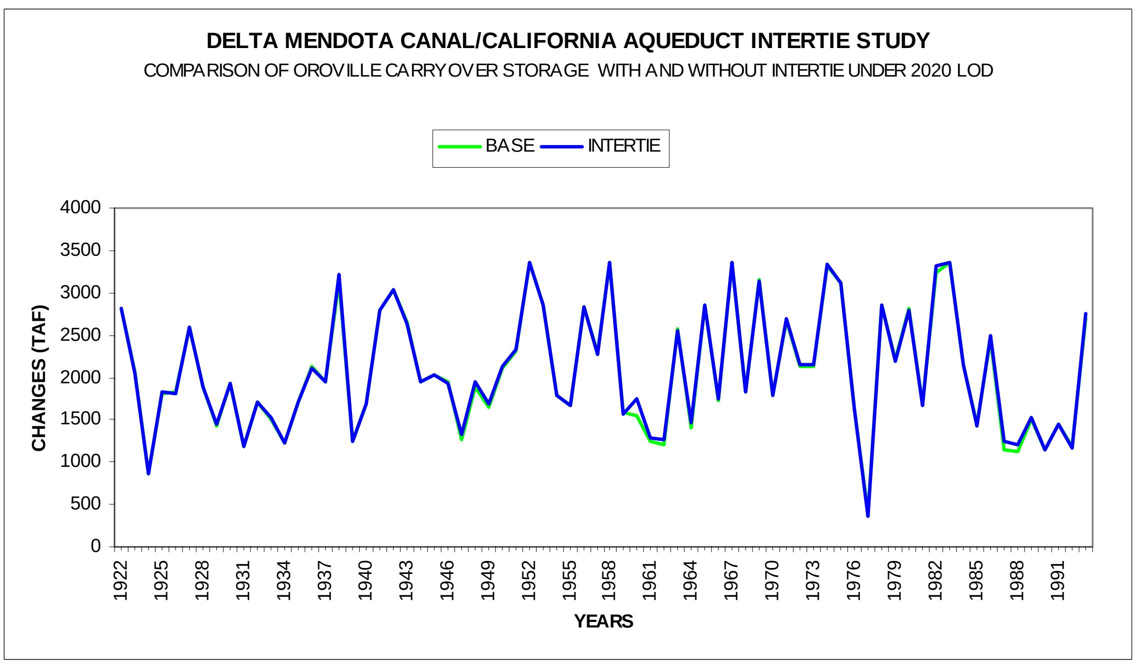

Figure 12: Oroville carryover storage under 2020 LOD.

Export Impacts

Figure 13 shows the average changes to Tracy pumping by month for each of the five 40-30-30 Sacramento Valley water types. Tracy pumping shows increases in October through February and to a lesser extent in August and September. Noteworthy is the decrease in March pumping at Tracy due to the restored ability to fill CVP San Luis earlier in the year. This implies that the CVP has restored some operational flexibility that may allow the project to operate more effectively around periods of export restrictions. The study shows substantial benefit of the Intertie in most water year types. Critical years, as expected due to low Delta flows and low allocations, show little Tracy benefit from the Intertie. Figure 14 shows the relative changes in Tracy and Banks exports for each year in the study. Banks PP shows decreases due to both a reduction in SWP pumping and a decrease in CVP use of JPOD. SWP's decrease in pumping averages 13 taf/yr for the 73-year study period.

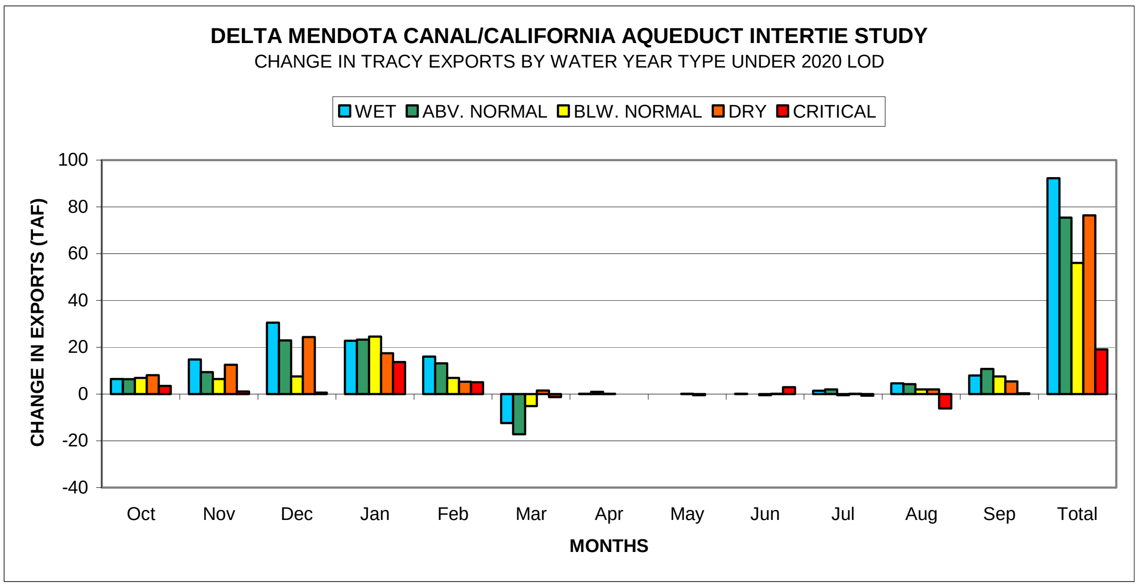

Figure 13: Monthly change in Tracy exports with Intertie by water year type under 2020 LOD.

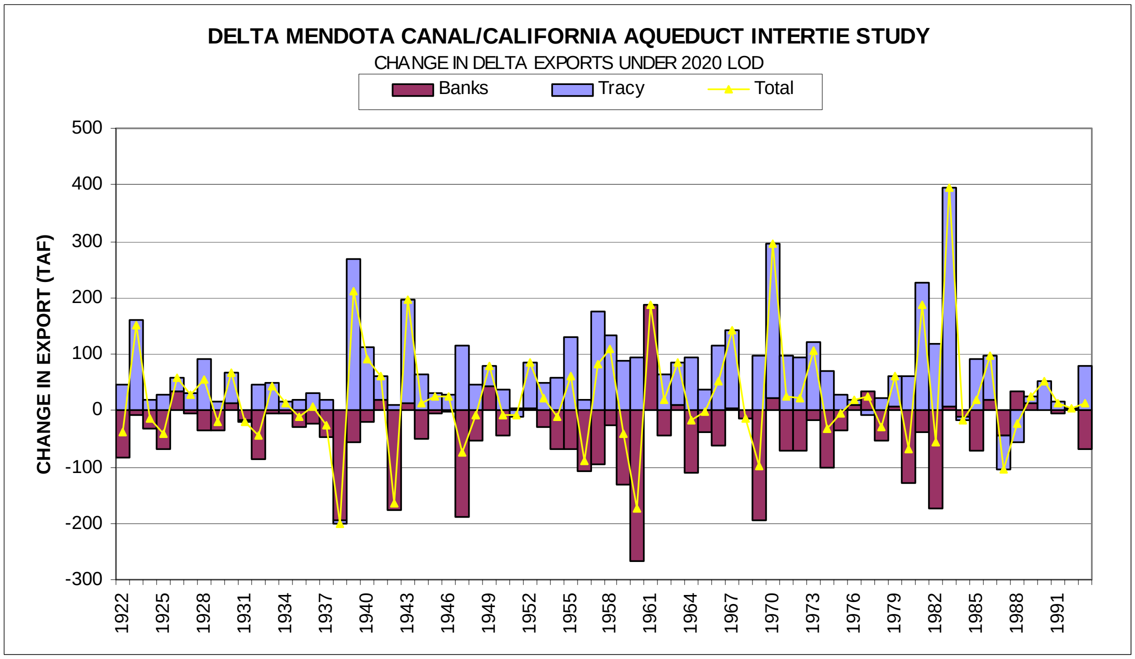

Figure 14: Changes in annual Delta exports with Intertie under 2020 LOD.

Delta Outflow Impacts

The Delta outflow reflects a combination of required flows for water quality and flow standards as well as surplus flows during wet periods. The water supply benefits of the Intertie project are largely realized through greater capture of surplus Delta flows during Oct-Mar. As a result, surplus Delta outflows decrease by an average of 54 taf/yr. The increased pumping in the Winter, however, does cause a minor increase in required Delta outflows in the Spring. The required Delta outflows increase by an average of 27 taf/yr and are predominantly due to additional flow requirements for the X2 standard. Total Delta outflow (the sum of required and surplus outflows) decreases by an average of 26 taf/yr. Once again, changes to surplus Delta outflows reflect the source of most of the additional exports for the Intertie study. Figure 15 shows the changes in annual Delta outflow for the Intertie study and the nearly mirror-image of change in total Delta exports.

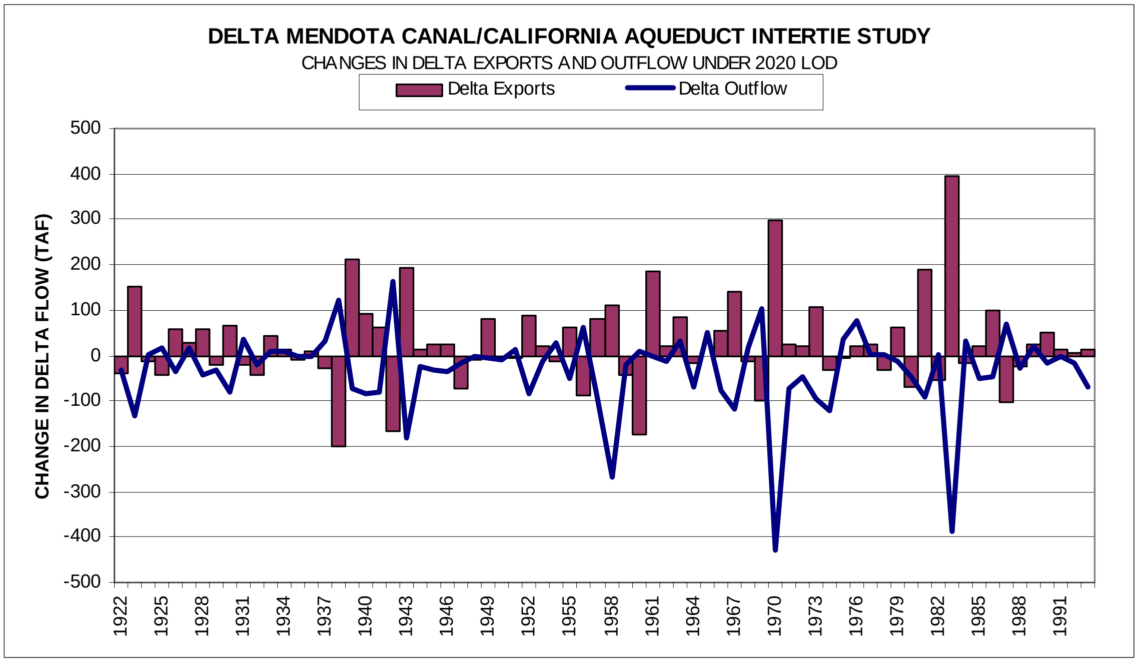

Figure 15: Changes in Delta exports and outflow with Intertie (TAF/yr) under 2020 LOD.

CVPIA (b)(2) Impacts

In order to operate to a relatively consistent environmental condition, the fish protective actions simulated in the Base study were fixed in the Intertie Alternative study. This is shown graphically in Figure 16. The total (b)(2) cost of performing the same actions in the Intertie study is reduced from the Base study. As can be seen in Figure17, the cost of satisfying the CVP WQCP Delta requirements remains about the same between the Base and Intertie studies, although there is a minor reduction in overall (b)(2) costs (Figures 18 and 19). The overall (b)(2) cost reduction appears largely due to the earlier filling of CVP San Luis and the subsequently reduced need of the CVP to pump during April, May, and June. It is during these months when the majority of the discretionary (b)(2) actions occur. Since Tracy pumping is lower, the cost of making cuts to satisfy a particular VAMP export limit, and/or associated extensions, is reduced. For example, in water year 1952, the (b)(2) cost of satisfying the WQCP standards is only minimally reduced (from 368 taf to 359 taf) in the Intertie study. However, the cost of the discretionary (b)(2) actions is reduced by 111 taf. The resulting total (b)(2) cost for this year is 662 taf in the Intertie study; down from 773 taf in the Base study. The cost of the performing the VAMP export curtailment is the most significant reduction for this year in the Intertie study. Over the entire 73-year study period the total (b)(2) cost has been reduced by 25 taf/yr in the Intertie study.

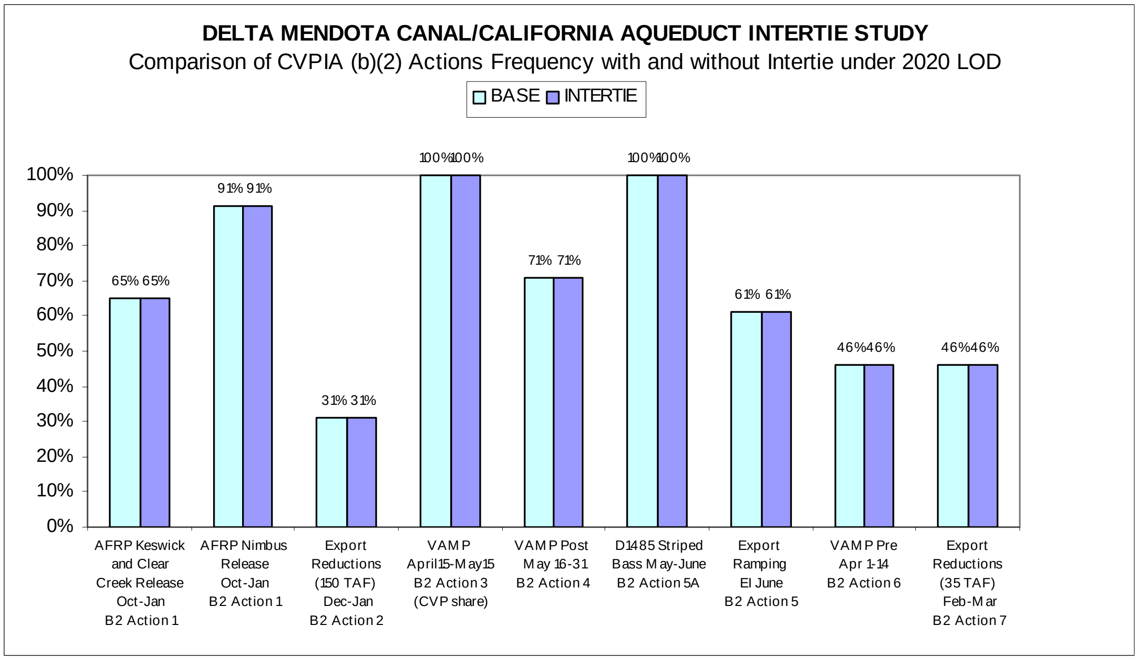

Figure 16: Comparison of frequency of CVPIA (b)(2) actions taken in 2020 LOD Base and Intertie studies.

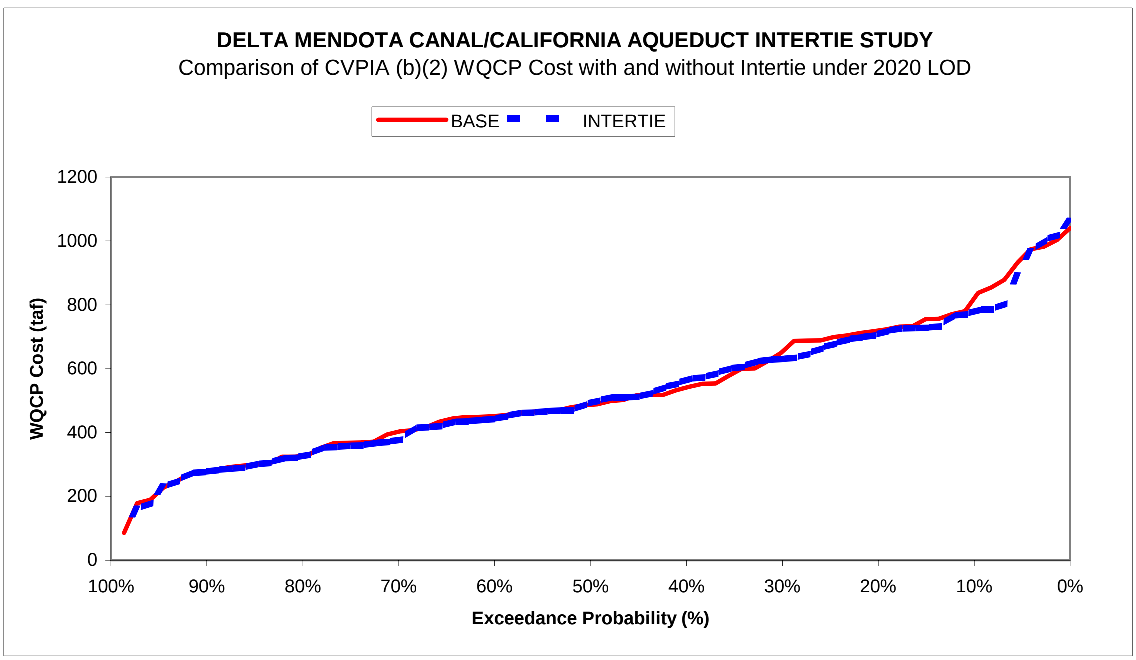

Figure 17: Comparison of the (b)(2) WQCP costs between 2020 LOD Intertie and Base studies.

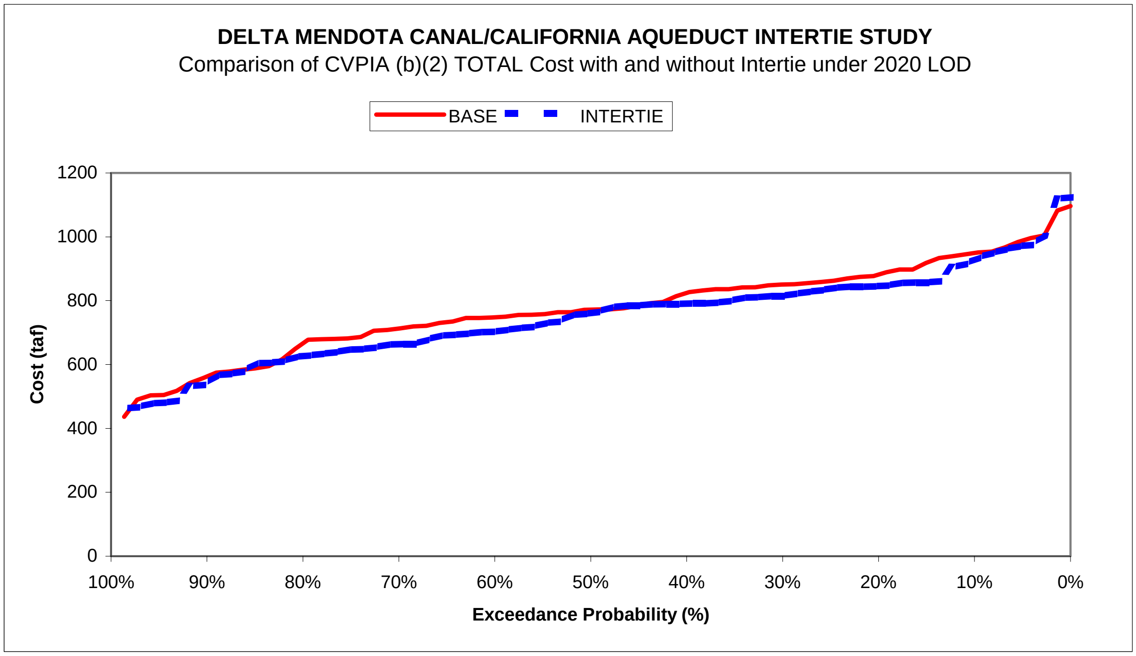

Figure 18: Comparison of the total cost of (b)(2) actions taken between 2020 LOD Intertie and Base Studies.

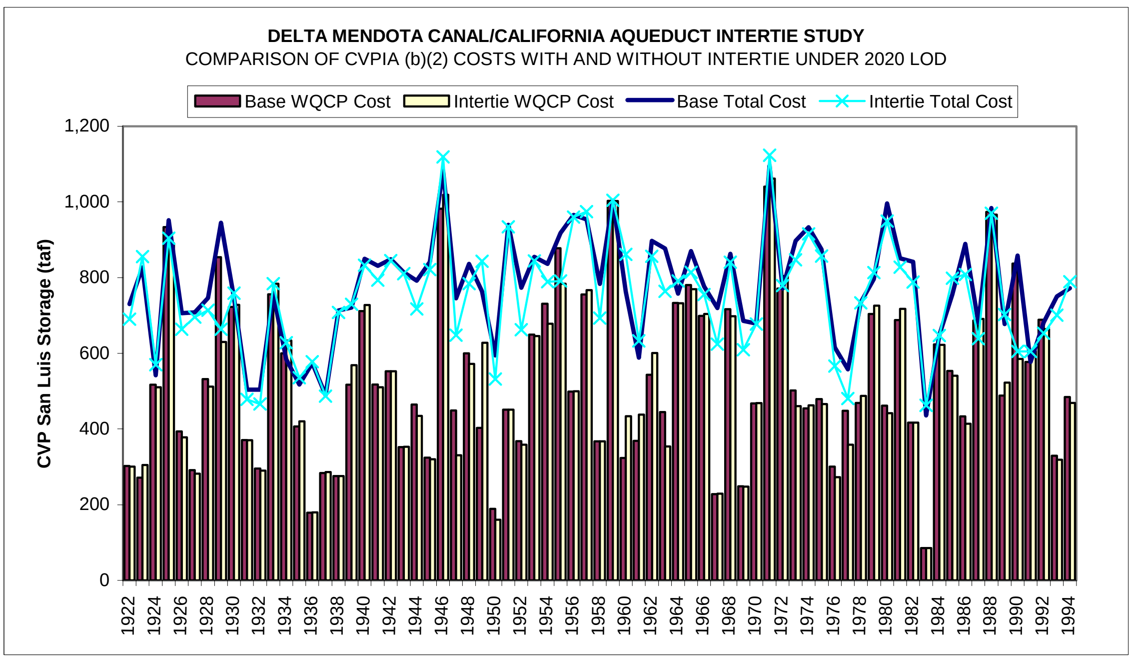

Figure 19: Comparison of the CVPIA (b)(2) costs between 2020 LOD Intertie and Base Studies.

EWA Impacts

Similar to the (b)(2) actions, the EWA fish protective actions simulated in the Base studies were fixed in the Intertie study. This is shown graphically in Figure 20. EWA actions generally reduce the SWP and CVP exports from a certain pre-EWA baseline level during fish critical months. When EWA actions are taken, lower pre-EWA pumping translates into lower EWA costs for the action. Figure 21 shows the change in average monthly pre-EWA Delta exports for the Intertie study. Increases in Delta exports mostly occurs in the December through February period when the Intertie allows Tracy to pump at maximum capacity. However, the Delta exports are decreased in March and are relatively unchanged in April, May, and June. Since most of the EWA high priority fish protective actions are envisioned in the March through June period, the cost of such actions is likely to unaffected, or reduced, by the Intertie operation. EWA export curtailments envisioned in the December through February period may increase in cost, but these are considered less likely to occur and are generally of lower priority than the Spring actions.

The overall results of the CALSIM II simulations show that the Intertie project does not adversely affect the operations of the EWA. The Intertie studies do not show an increase in the debt that is accumulated by the EWA; nor do they show any reduction in the ability of EWA to move purchased water from NOD to SOD. In fact, the studies show that the average debt is slightly reduced and that EWA exports are increased in the Intertie study, however, the changes are so minor as to be considered insignificant for this level of analysis.

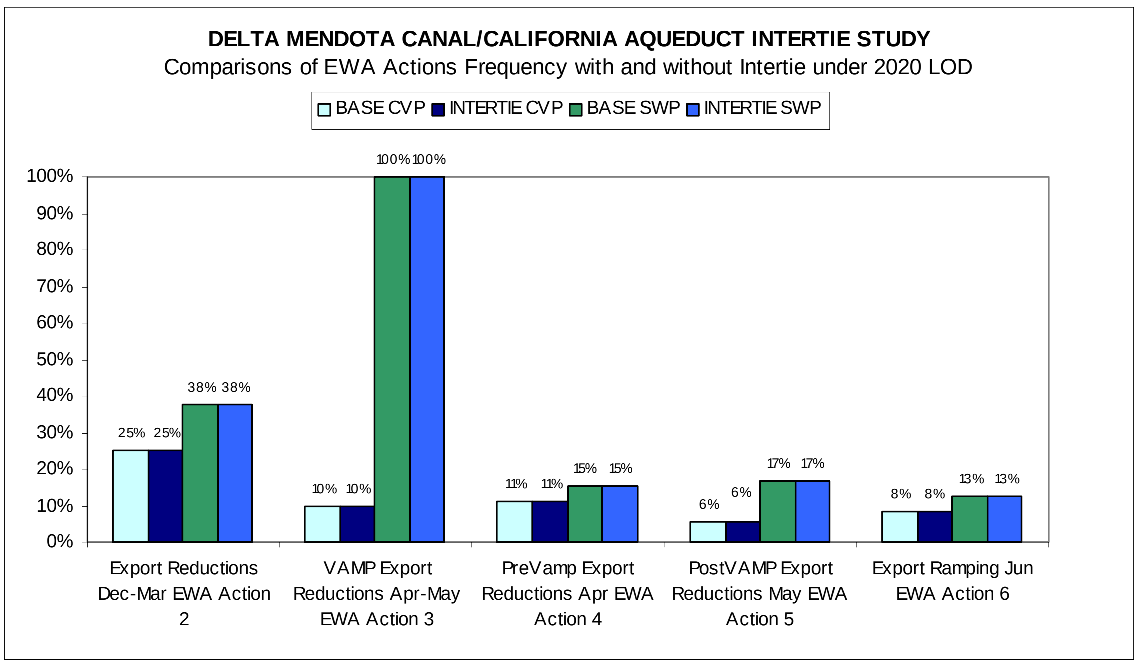

Figure 20: Frequency of EWA Actions taken by CVP and SWP in the 2020 LOD Base and Intertie studies.

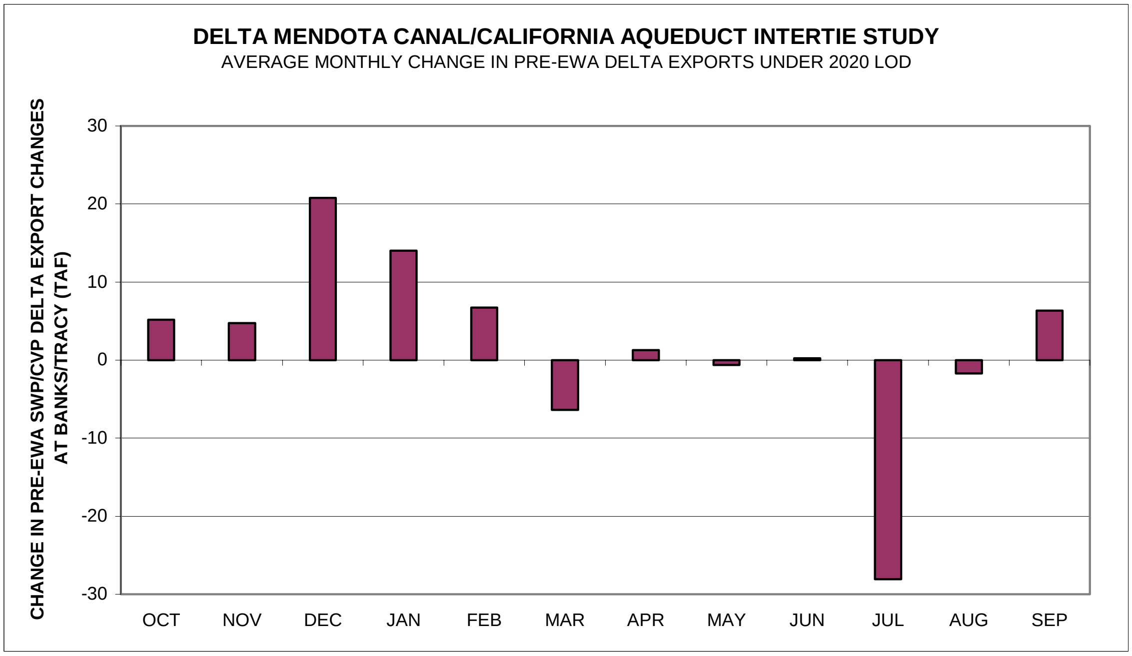

Figure 21: Average monthly change in pre-EWA Delta exports under 2020 LOD.

2001 Level of Development Study Results

The Intertie study was repeated for the Existing Condition using the 2001 LOD study as a Base. The plots and tables for the study based on the Future No Action (2001 LOD) are reproduced here for comparison of impacts due to Level of Development.

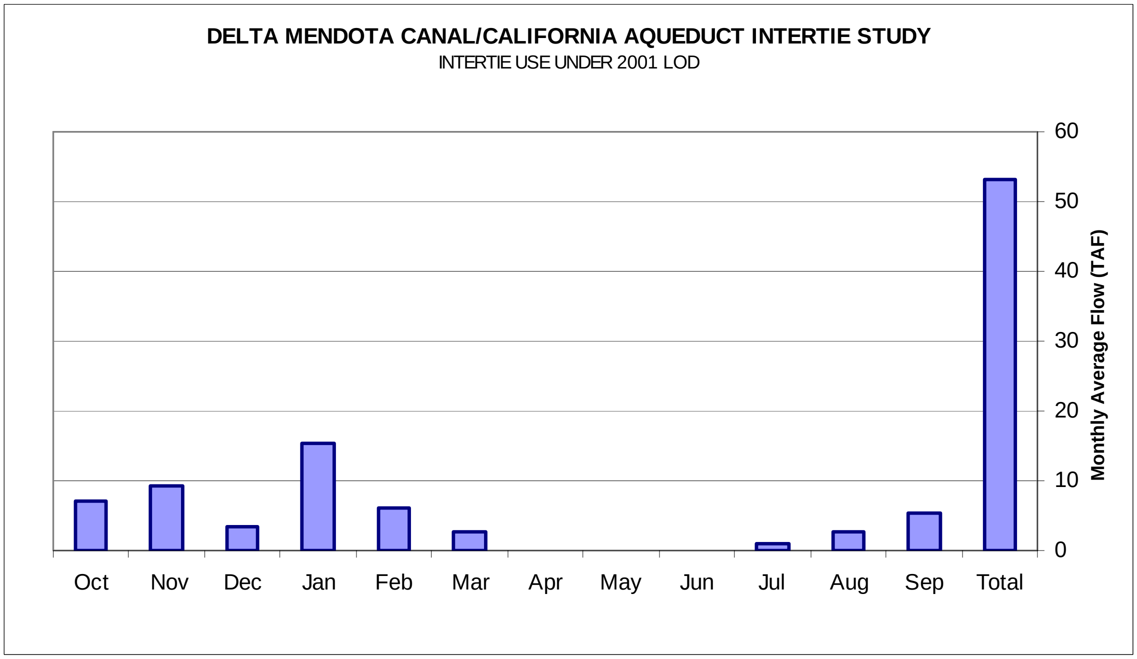

Figure 22. Monthly average Intertie flows (taf) under 2001 LOD.

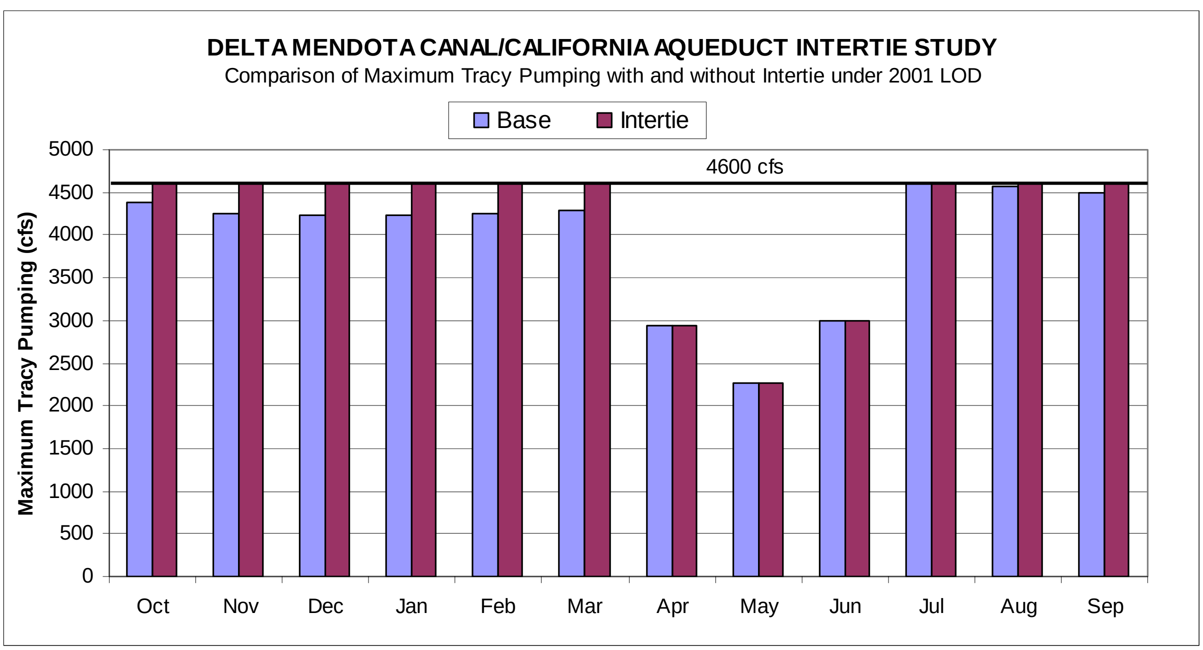

Figure 23: Monthly maximum Tracy pumping (cfs) under 2001 LOD.

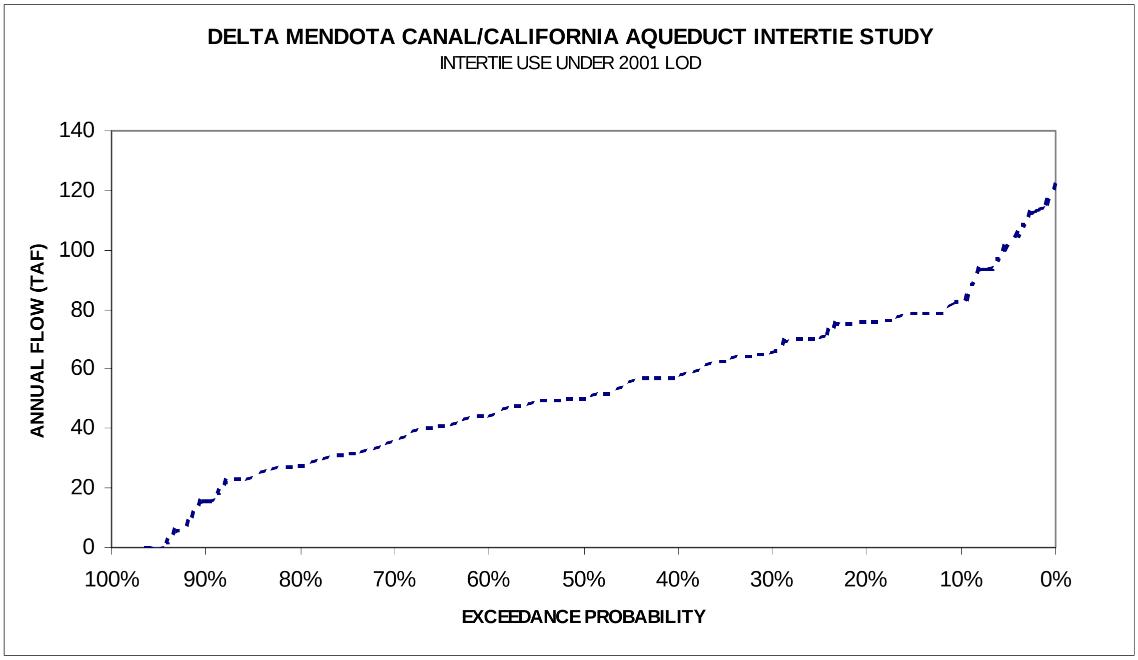

Figure 24: Exceedance probability of annual Intertie use (taf/yr) under 2001 LOD.

Table 3: Change in water supply deliveries with Intertie under 2001 LOD.

2001 LOD	DRY PERIOD AVERAGE (1928-34)			73-YEAR AVERAGE (1922-1994)		
	BASE	ALTERNATIVE	CHANGE	BASE	ALTERNATIVE	
CVP DELIVERY NOD	1962	1970	7	2205	2208	2
CVP DELIVERY SOD (INCL.CVC)	1675	1715	40	2485	2521	36
CVP DELIVERY TOTAL	3637	3685	48	4691	4729	38
SWP DELIVERY FIRM	2025	1997	-28	3087	3079	-8
SWP DELIVERY ARTICLE 21	124	118	-6	136	132	-5
SWP DELIVERY TOTAL*	2149	2116	-34	3223	3211	-12

* As SWP Entitlement A Delivery

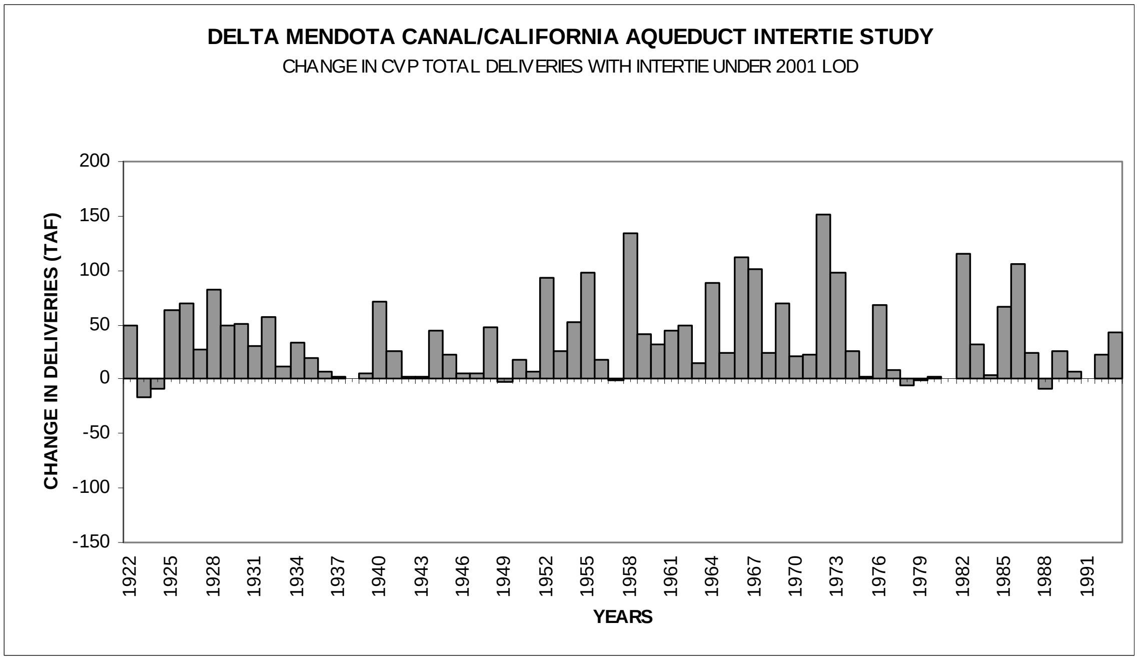

Figure 25: Change in CVP total deliveries with Intertie under 2001 LOD.

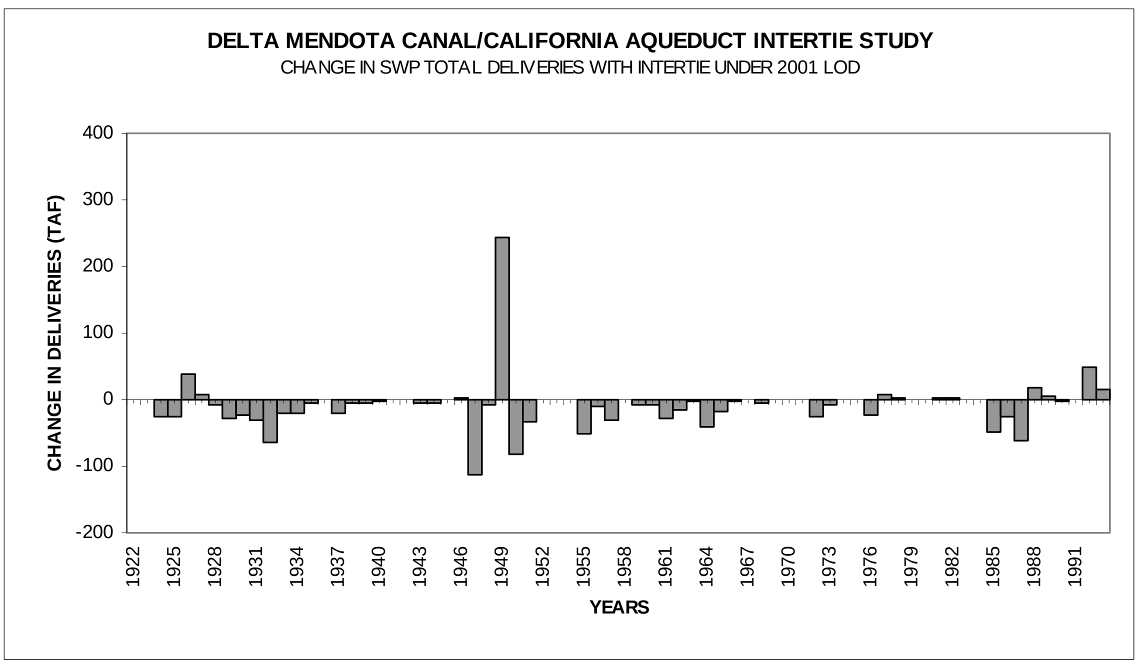

Figure 26: Change in SWP SOD total deliveries with Intertie under 2001 LOD.

The model delivery allocation procedure over-adjusted SWP deliveries in 1949 due to increased storage from 1947-48 water years. The over-allocation in 1949, and subsequent lower SWP storage, is again corrected for by reductions in allocation in 1950 and 1951. If averaged over the 1947-51 period, the SWP deliveries are only increased by 2 taf/yr.

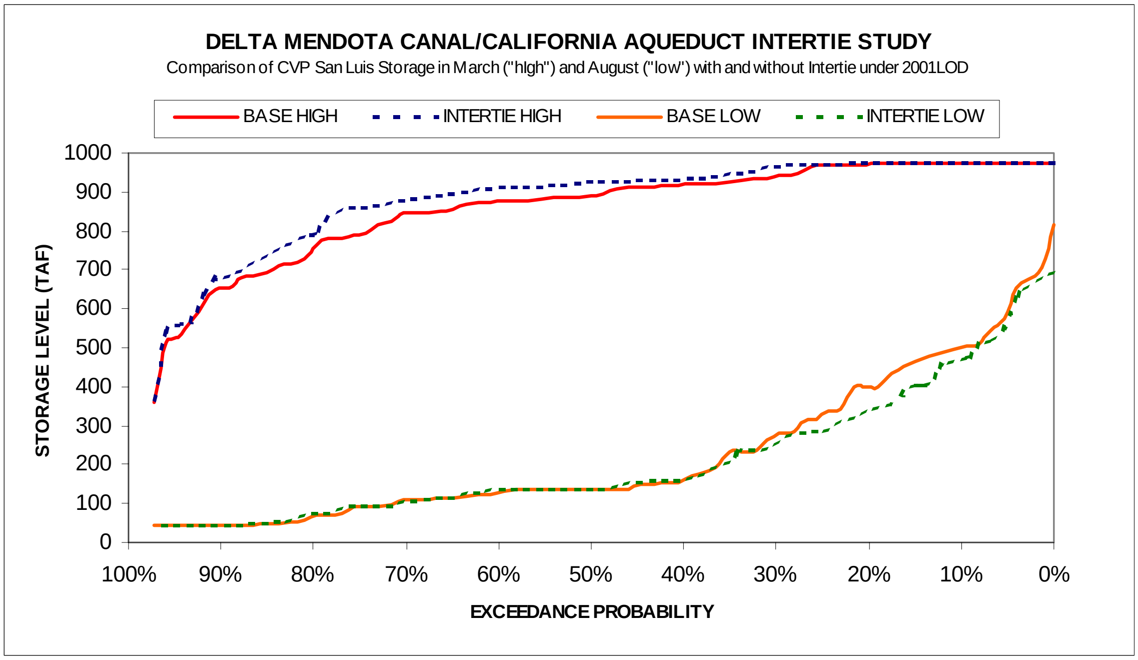

Figure 27: Comparison of CVP San Luis storage in March ("high") and August ("low") under 2001 LOD.

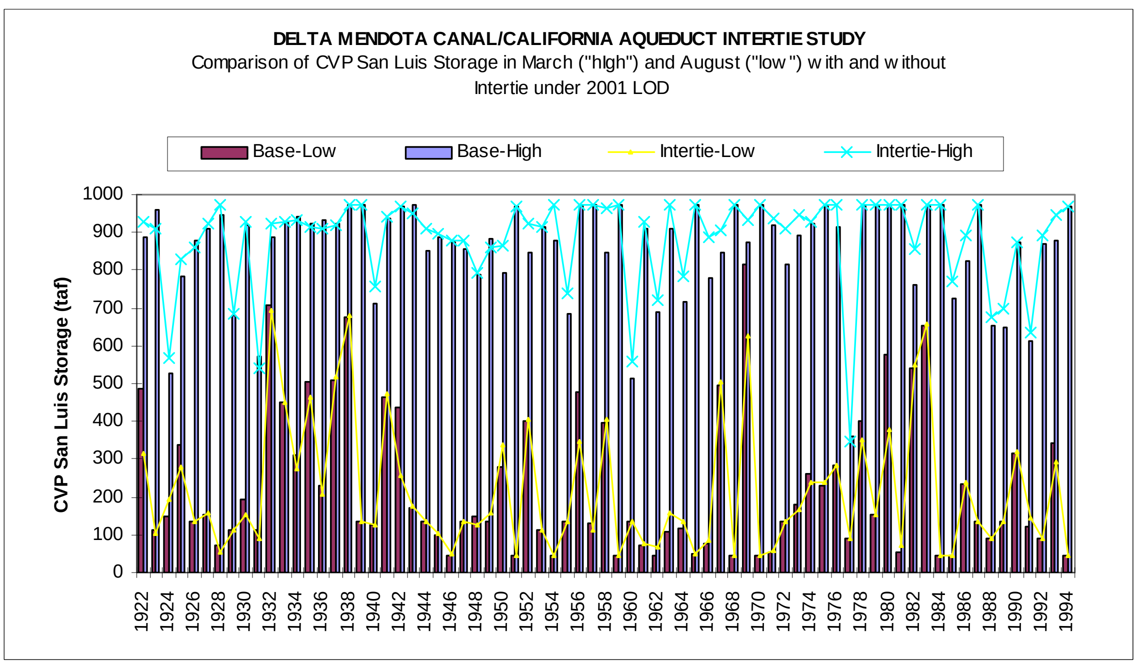

Figure 28: Comparison of CVP San Luis annual storage in March ("high") and August ("low) under 2001 LOD.

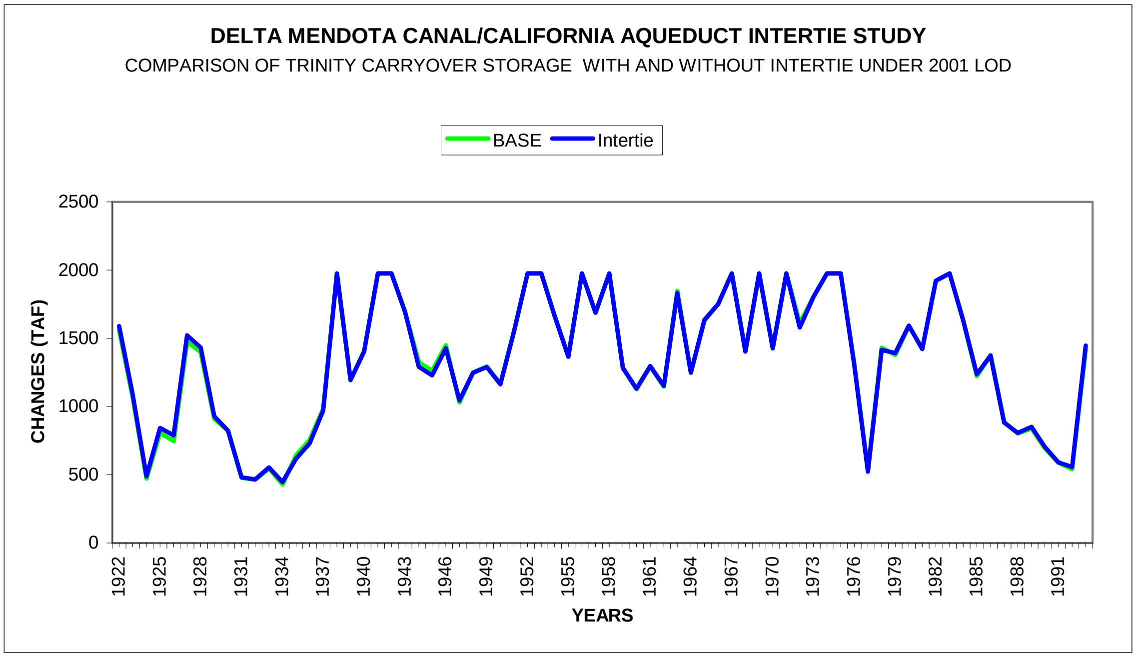

Figure 29: Trinity carryover storage under 2001 LOD.

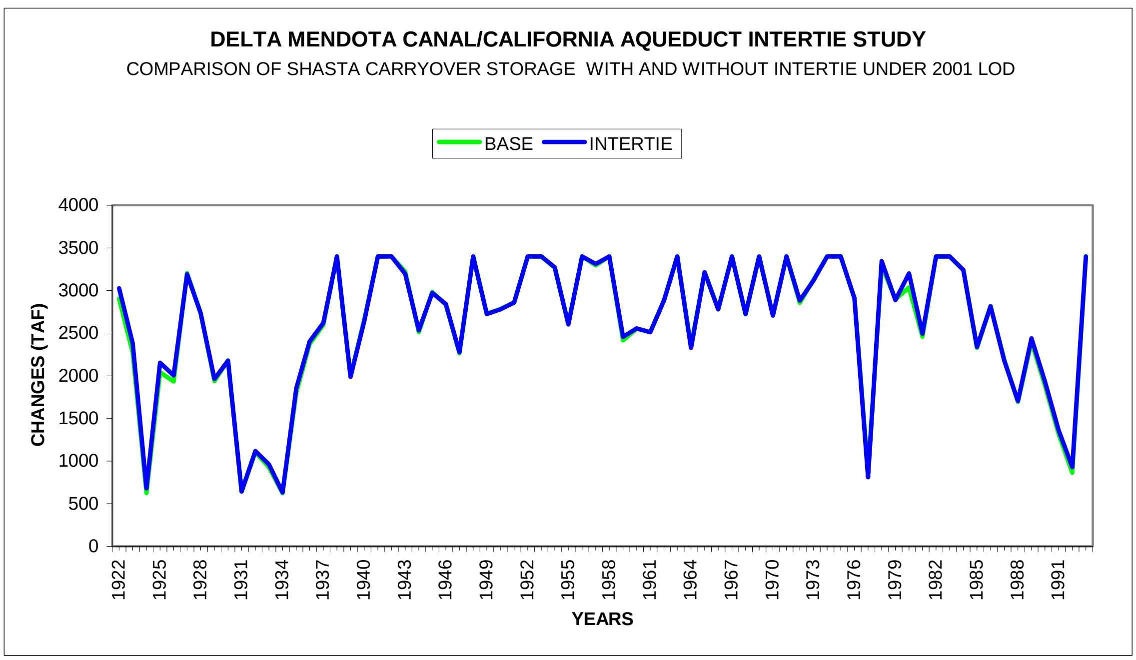

Figure 30: Shasta carryover storage under 2001 LOD.

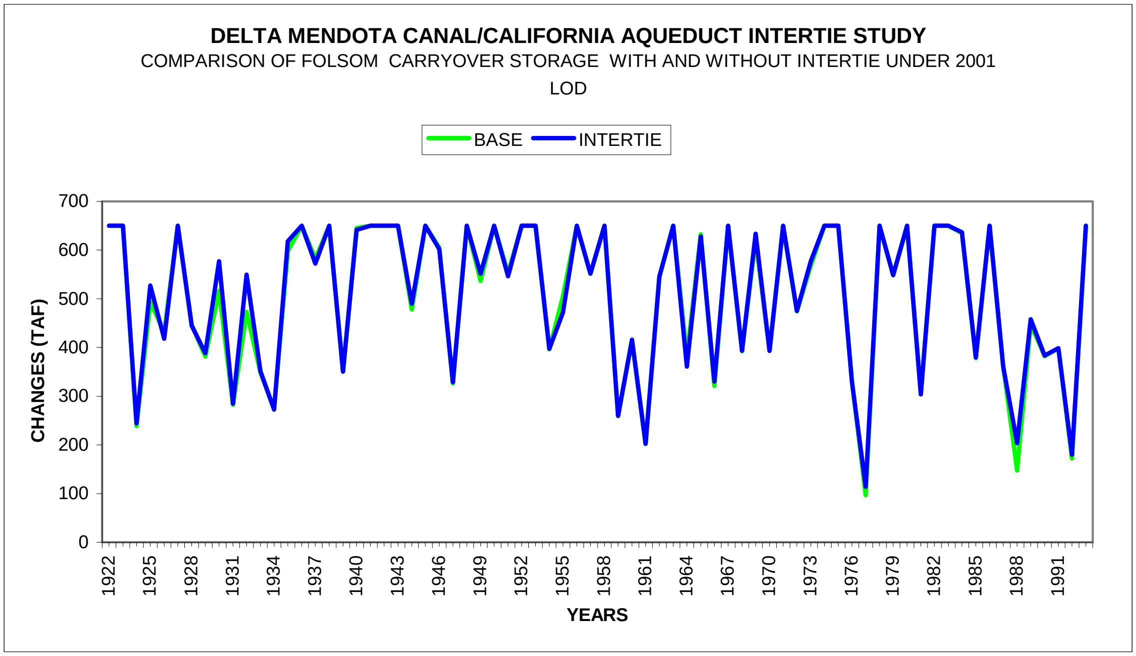

Figure 31: Folsom carryover storage under 2001 LOD.

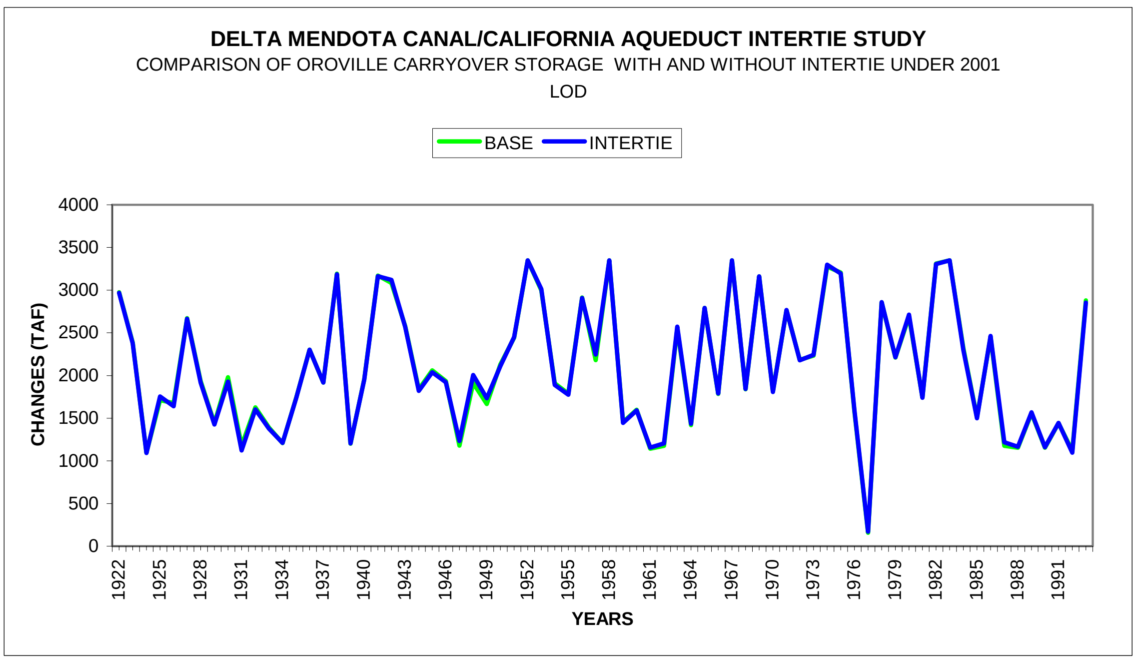

Figure 32: Oroville carryover storage under 2001 LOD.

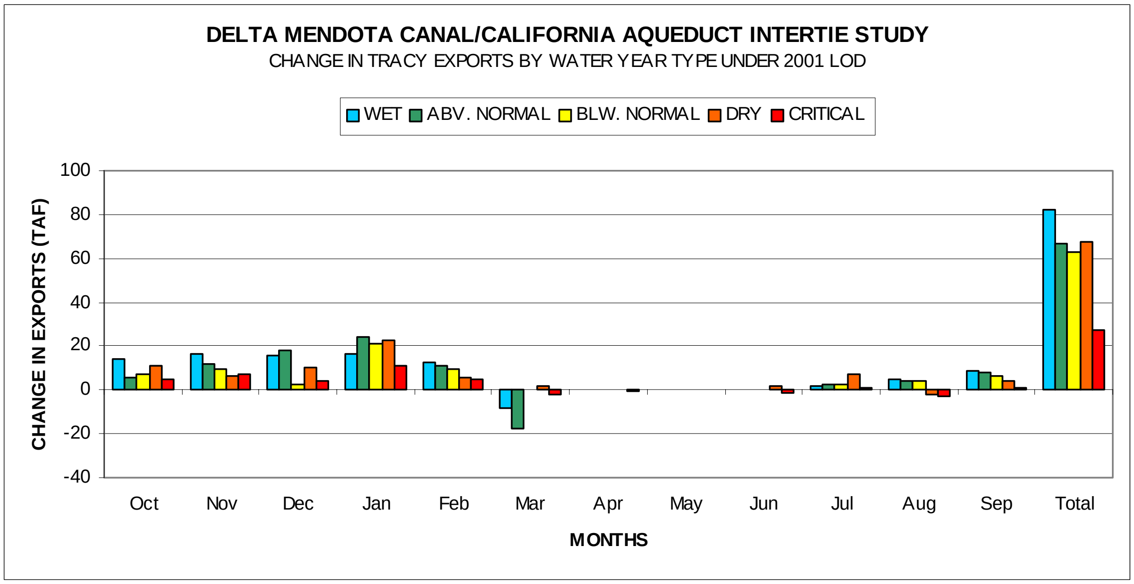

Figure 33: Monthly change in Tracy exports with Intertie by water year type under 2001 LOD.

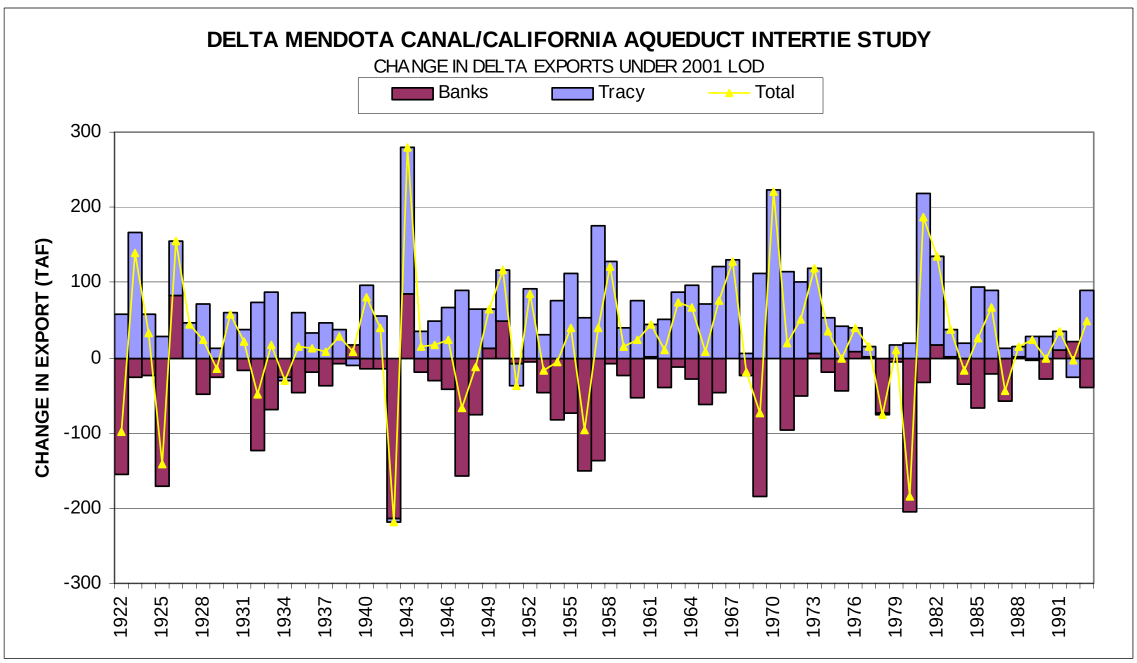

Figure 34: Changes in annual Delta exports with Intertie under 2001 LOD.

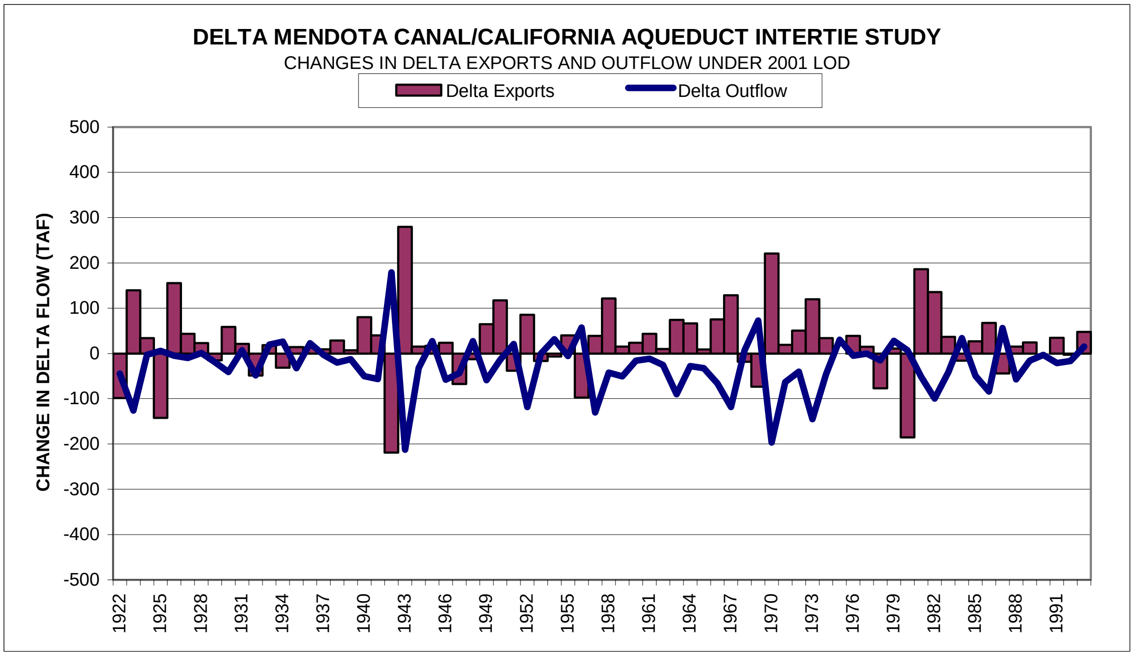

Figure 35: Changes in Delta exports and outflow with Intertie (TAF/yr) under 2001 LOD

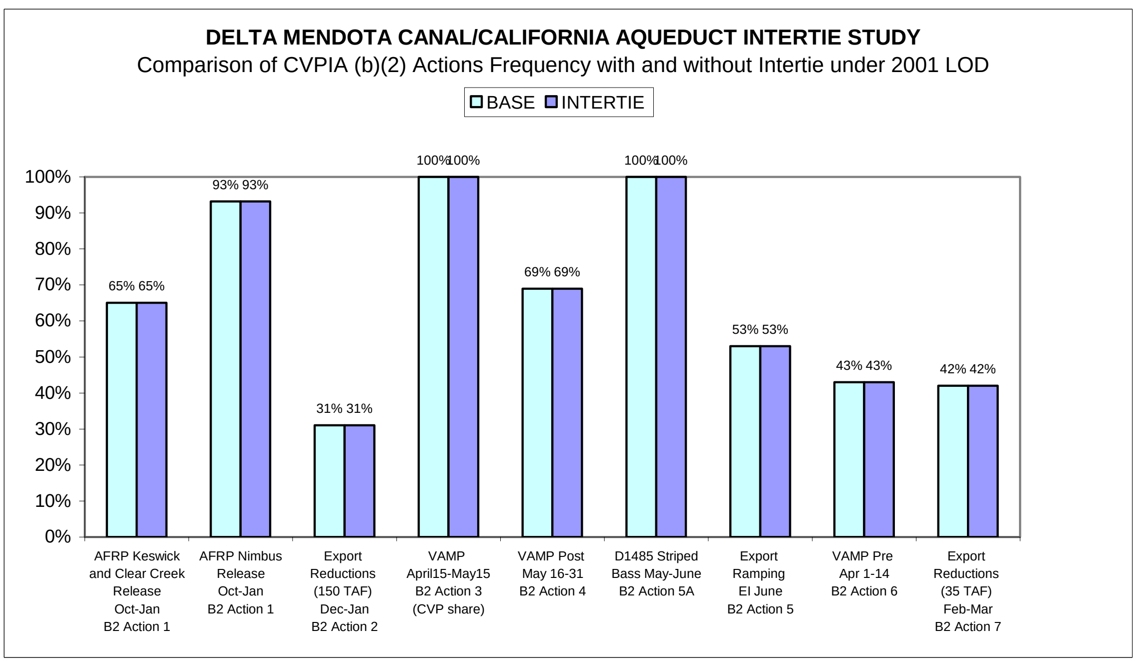

Figure 36: Comparison of frequency of CVPIA (b)(2) actions taken in 2001 LOD Base and Intertie studies.

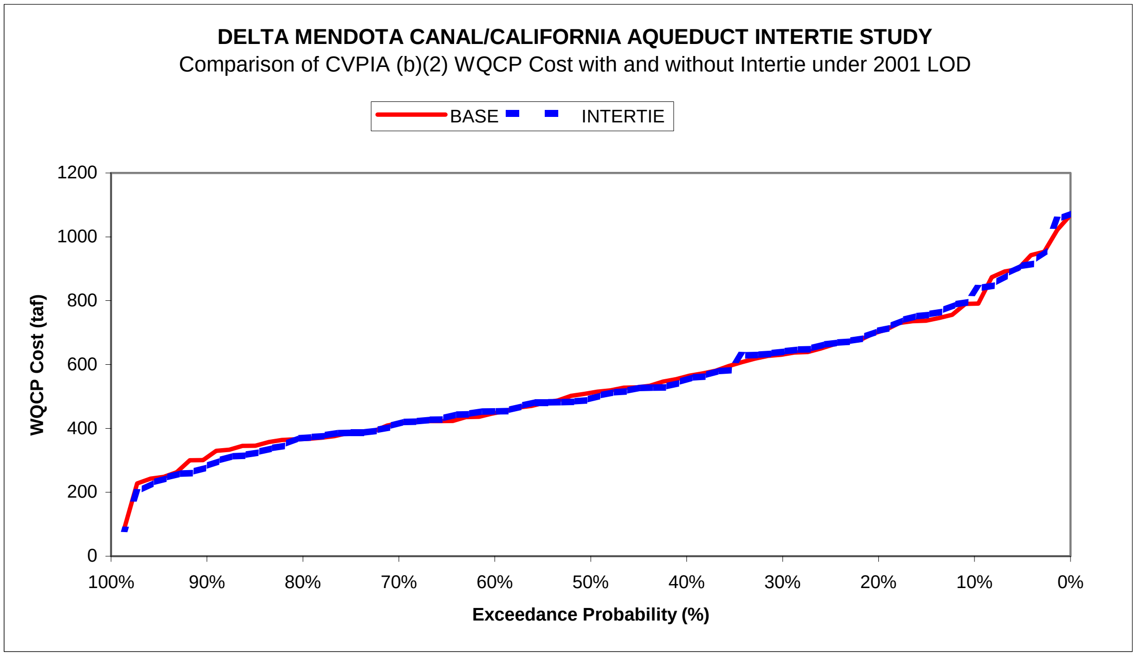

Figure 37: Comparison of the (b)(2) WQCP costs between 2001 LOD Intertie and Base studies.

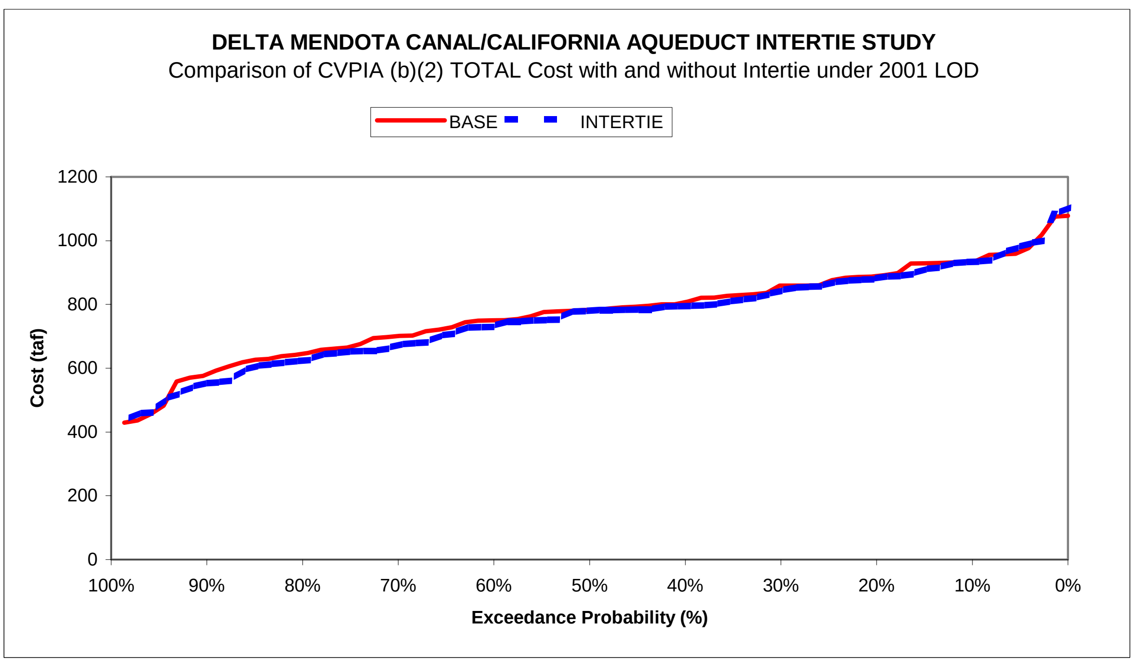

Figure 38: Comparison of the total cost of (b)(2) actions taken between 2001 LOD Intertie and Base Studies.

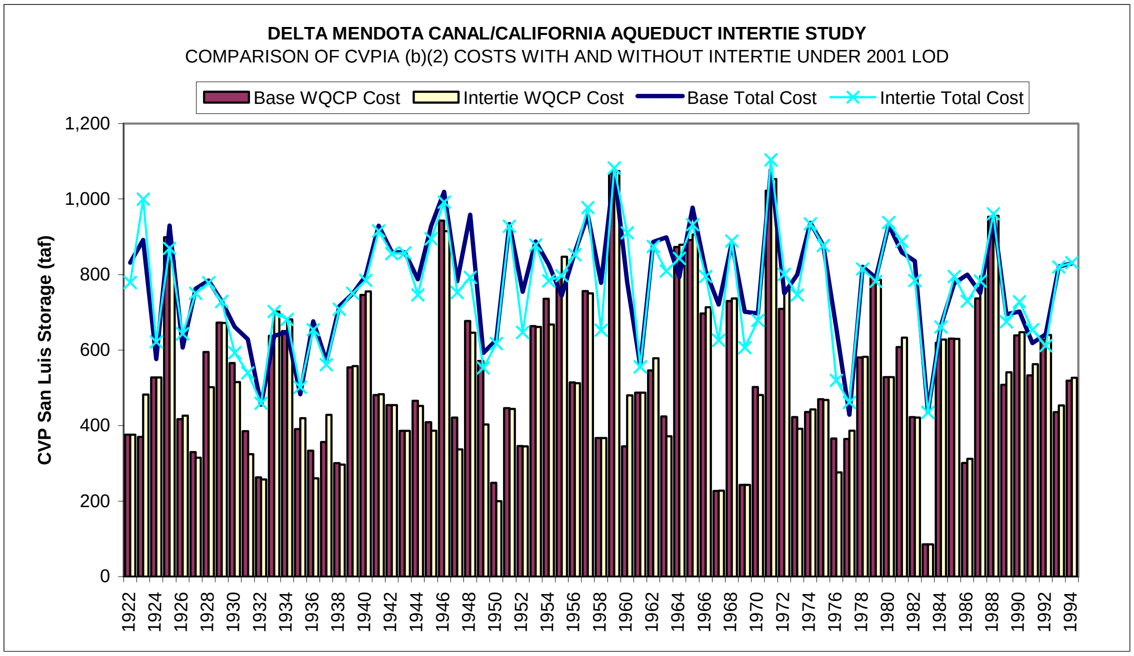

Figure 39: Comparison of the CVPIA (b)(2) costs between 2001 LOD Intertie and Base Studies.

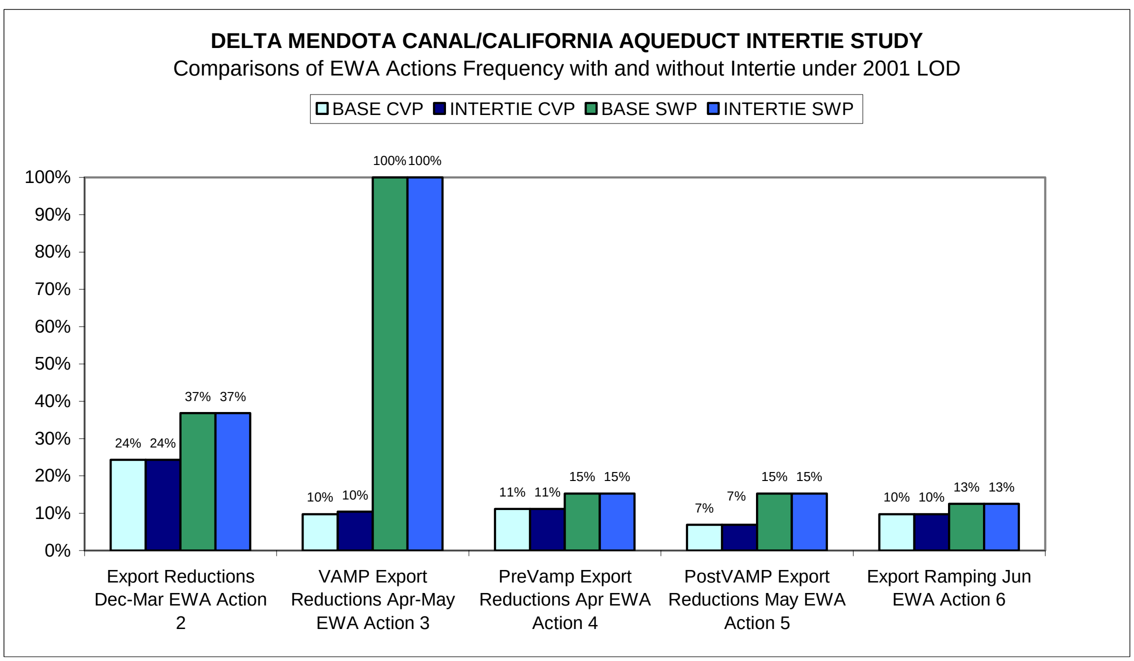

Figure 40: Frequency of EWA Actions taken by CVP and SWP in the 2001 LOD Base and Intertie studies.

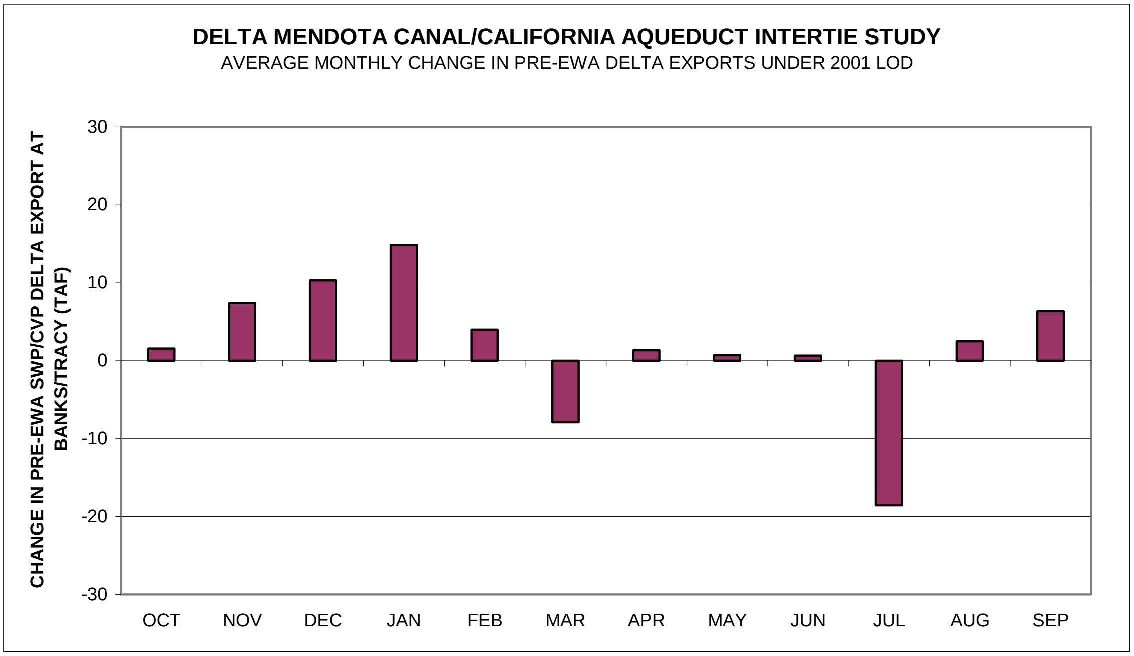

Figure 41: Average monthly change in pre-EWA Delta exports under 2001 LOD.